# ENVIRONMENTAL RESOURCES DOCUMENT

**National Aeronautics and Space Administration**
**Goddard Space Flight Center**
**Wallops Flight Facility**
**Wallops Island, Virginia 23337**


**October 1999**

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Goddard Space Flight Center
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Wallops Island, Virginia

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**ABSTRACT:** This document was prepared according to the requirements of NASA's Regulations for Implementing the Procedures of the National Environmental Policy Act (NEPA) 14 CFR 1216.319, as a revision of the August 1994 Environmental Resources Document for the Wallops Flight Facility. NASA has reviewed this document and determined that it accurately and adequately describes the existing environment at NASA Goddard Space Flight Center's Wallops Flight Facility, Wallops Island, Virginia.

*THIS REVISION SUPERSEDES ALL PREVIOUS EDITIONS OF THE WALLOPS FLIGHT FACILITY ENVIRONMENTAL RESOURCES DOCUMENT*

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## LIST OF ACRONYMS AND ABBREVIATIONS

| | | |
|---|---|---|
| ACGIH | - | American Conference of Governmental Industrial Hygienists |
| ACSC | - | AEGIS Combat System Center |
| ACSCS | - | Accomack County Soil Conservation Service |
| ADT | - | Average Daily Traffic |
| AFFF | - | Aqueous Film Forming Foam |
| AFTF | - | Aviation Fuel Tank Farm |
| AHERA | - | Asbestos Hazard Emergency Response Act |
| AIA | - | Asbestos Information Act |
| AQMA | - | Air Quality Maintenance Area |
| ANSI | - | American National Standards Institute |
| AOL | - | Airborne Oceanographic Lidar |
| ASHRAE | - | American Society of Heating, Refrigerating, and Air-conditioning Engineers |
| ASR | - | Atmospheric Systems Research |
| ASRF | - | Atmospheric Sciences Research Facility |
| AST | | Aboveground Storage Tank |
| $BOD_5$ | - | Biological Oxygen Demand - 5 Day |
| CAS | - | Chemical Abstracts Service |
| CDA | - | Command and Data Acquisition |
| CERCLA | - | Comprehensive Environmental Response, Compensation, and Liability Act |
| CEQ | - | Council on Environmental Quality |
| cfm | - | Cubic Feet per Minute |
| CFR | - | Code of Federal Regulations |
| CNWR | - | Chincoteague National Wildlife Refuge |
| COBE | - | Cosmic Background Explorer Satellite |
| COE | - | U. S. Army Corps of Engineers |
| COMET | - | Commercial Experiment Transporter |
| dB | - | decibel |
| dBA | - | decibel, weighted to the A-scale |
| DAPC | - | Department of Air Pollution Control |
| DEQ | - | Department of Environmental Quality |
| DMR | - | Discharge Monitoring Reports |
| DNH | - | Division of Natural Heritage |
| DNL | - | Day-Night Level |
| EA | - | Environmental Assessment |
| EB | - | Environmental Branch |
| EIS | - | Environmental Impact Statement |
| ELS | - | Environmental Law Statutes |
| ELV | - | Expendable Launch Vehicle |
| EO | - | Enforcement Order |
| EPA | - | Environmental Protection Agency |
| EPD | - | Emergency Planning District |
| ERD | - | Environmental Resources Document |
| EVOC | - | Emergency Vehicle Operations Class |
| FAA | - | Federal Aviation Administration |
| FAST | - | Fast Aurora Snapshot Explorer |
| FEB | - | Facilities Engineering Branch |

| | | |
|---|---|---|
| FEMA | - | Federal Emergency Management Agency |
| FHCTP | - | Federal Hazard Communication Training Program |
| FHWA | - | Federal Highway Administration |
| FIS | - | Flood Insurance Study |
| FOTW | - | Federally Owned Treatment Works |
| ft | - | Feet |
| FY | - | Fiscal Year |
| GHz | - | Gigahertz |
| GLES | - | Goddard Leadership Education Series |
| GOES | - | Geostationary Operational Environmental Satellite |
| gpm | - | Gallons per Minute |
| gpd | - | Gallons per Day |
| gpd/ft | - | Gallons per Day per Foot |
| GPS | - | Global Positioning System |
| GSFC | - | Goddard Space Flight Center |
| HAARP | - | High-Frequency Active Auroral Research Program |
| HAZCOM | - | Hazard Communication |
| HP | - | Horsepower |
| HSCT | - | High Speed Civil Transport |
| HTPB | - | Hydroxyl-Terminated Polybutadiene |
| Hz | - | Hertz |
| IEEE | - | Institute of Electrical and Electronics Engineers |
| IMP-8 | - | Interplanetary Monitoring Platform Satellite |
| IR | - | Infra-red |
| IUE | - | International Ultraviolet Explorer Satellite |
| KeV | - | Kilo electron Volts |
| Kg | - | Kilogram |
| Km | - | Kilometers |
| KWH | - | Kilowatt Hours |
| LaRC | - | Langley Research Center |
| LASER | - | Light Amplification by Stimulated Emission of Radiation |
| LBEF | - | Land-Based Engineering Facility |
| LEPC | - | Local Emergency Planning Committee |
| $L_{dn}$ | - | Day-night Average Sound Level |
| LISTS | - | Locator Information Services Tracking System |
| $L_{eg}$ | - | Time-Averaged Sound Energy Level |
| LSE | - | Lifetime Support Engineering |
| MandE | - | Metcalf and Eddy, Incorporated |
| MAC | - | Morale Activities Committee |
| MAST | - | Management and Supervisory Training |
| MCL | - | Maximum Contaminant Level |
| MEC | - | Management Education Center |
| MEP | - | Management Education Program |
| MeV | - | Mega electron Volts |
| MGD | - | Million Gallons per Day |

| | | |
|---|---|---|
| mg/l | - | milligrams per liter |
| $mg/hr/m^3$ | - | milligrams per cubic meter per hour |
| MHz | - | Megahertz |
| MILS | - | Microwave Landing System |
| MLW | - | Mean Low Water |
| MLS | - | Microwave Landing System |
| mm/yr | - | millimeters per year |
| MOLA | - | Mars Observer Lander Satellite |
| MSDS | - | Material Safety Data Sheet |
| $mw/cm^2$ | - | milliwatts per square centimeter |
| NAAQS | - | National Ambient Air Quality Standards |
| NAAS | - | Naval Auxiliary Air Station |
| NACA | - | National Advisory Committee for Aeronautics |
| NASA | - | National Aeronautics and Space Administration |
| NASCOM | - | NASA Communications System |
| NAWC | - | Naval Air Warfare Center |
| NAWC/AD | - | Naval Air Warfare Center/Aircraft Division |
| NFPA | - | National Fire Protection Association |
| NIST | - | National Institute of Standards and Testing |
| NCRP | - | National Council on Radiation Protection and Measurement |
| NEPA | - | National Environmental Policy Act |
| NESDIS | - | National Environmental Satellite and Data Information System |
| NIOSH | - | National Institute of Occupational Safety and Health |
| NOAA | - | National Oceanic and Atmospheric Administration |
| NOI | - | Notice of Intent |
| NPDES | - | National Pollutant Discharge Elimination System |
| NRC | - | Nuclear Regulatory Commission |
| NSWC | - | Naval Surface Warfare Center |
| NSP | - | National Aerospace Plane |
| NSROC | - | NASA Sounding Rocket Operations Contract |
| NSWCDD | - | Naval Surface Warfare Center Dahlgren Division |
| NWI | - | National Wetland Inventory |
| $N_2O_4$ | - | Nitrogen Tetroxide |
| OandM | - | Operating and Maintenance |
| OBOD | - | Open Burn/ Open Detonation |
| OSHA | - | Occupational Safety and Health Administration |
| OSPL | - | Overall Sound Pressure Level |
| PARD | - | Pilotless Aircraft Research Division |
| PCM | - | Pulse Coded Modulation |
| PFRR | - | Poker Flat Research Range |
| ppb | - | parts per billion |
| ppm | - | parts per million |
| RandD | - | Research and Development |
| RADTRAC | - | Radar Tracking System |
| RARF | - | Radar Atmospheric Research Facility |
| RCRA | - | Resource Conservation and Recovery Act |

| | | |
|---|---|---|
| RfR | - | Radio-frequency Radiation |
| RDTandE | - | Research, Development, Testing and Evaluation |
| SAR | - | Specific Absorption Rate |
| SARA | - | Superfund Amendments and Reauthorization Act |
| SCR | - | Surface Contour Radar |
| SCS | - | Soil Conservation Service |
| SDIO | - | Strategic Defense Initiative Organization |
| SEASAT | - | Sea Satellite |
| SEL | - | Single Event Level |
| SELVS | - | Small Expendable Launch Vehicle Systems |
| SERC | - | State Emergency Response Commission |
| SIC | - | Standard Industrial Classification |
| SPANDAR | - | Space Range Radar |
| SPCC | - | Spill Prevention, Control, and Countermeasures |
| SQAB | - | Safety Quality and Assurance Branch |
| STEL | - | Short Term Exposure Limits |
| STS | - | Space Transportation System |
| TCLP | - | Toxicity Characteristic Leaching Procedure |
| TLV | - | Threshold Limit Values |
| TOPEX | - | Topography Experiment Satellite |
| TOTS | - | Transportable Orbital Tracking System |
| TQM | - | Total Quality Management |
| TRMM | - | Tropospheric Rainfall Measurement Mission |
| TSP | - | Total Suspended Particulates |
| TSS | - | Total Suspended Solids |
| TWA | - | Time Weighted Averages |
| UHF | - | Ultra High Frequency |
| USAF | - | United States Air Force |
| USCG | - | United States Coast Guard |
| USDA | - | United States Department of Agriculture |
| USDI | - | United States Department of Interior |
| USFWS | - | United States Fish and Wildlife Service |
| USGS | - | United States Geological Survey |
| USLSS | - | United States Life Saving Service |
| USN | - | United States Navy |
| USSR | - | Union of Soviet Socialist Republics |
| UST | - | Underground Storage Tank |
| UV | - | Ultraviolet |
| V/C | - | Vehicle/Capacity |
| VDGIF | - | Virginia Department of Game and Inland Fisheries |
| VDHR | - | Virginia Department of Historic Resources |
| VHF | - | Very High Frequency |
| VOC | - | Volatile Organic Compound |
| VPDES | - | Virginia Pollutant Discharge Elimination System |
| WHAFIS | - | Wave Height Analysis for Flood Insurance Study |
| WHAFIS3 | - | Wave Height Analysis for Flood Insurance Study, Version 3 |

| | | |
|---|---|---|
| WOTS | - | Wallops Orbital Tracking Station |
| WSMR | - | White Sands Missile Range |
| WVC | - | Wallops Visitor Center |
| WWTP | - | Wastewater Treatment Plant |

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| DNL | - | Day-Night Level |
| EA | - | Environmental Assessment |
| EB | - | Environmental Branch |
| EIS | - | Environmental Impact Statement |
| ELS | - | Environmental Law Statutes |
| ELV | - | Expendable Launch Vehicle |
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MSDS - Material Safety Data Sheet
$mw/cm^2$ - milliwatts per square centimeter
NAAQS - National Ambient Air Quality Standards
NAAS - Naval Auxiliary Air Station
NACA - National Advisory Committee for Aeronautics
NASA - National Aeronautics and Space Administration
NASCOM - NASA Communications System
NAWC - Naval Air Warfare Center
NAWC/AD - Naval Air Warfare Center/Aircraft Division
NFPA - National Fire Protection Association
NIST - National Institute of Standards and Testing
NCRP - National Council on Radiation Protection and Measurement
NEPA - National Environmental Policy Act
NESDIS - National Environmental Satellite and Data Information System
NIOSH - National Institute of Occupational Safety and Health
NOAA - National Oceanic and Atmospheric Administration
NOI - Notice of Intent
NPDES - National Pollutant Discharge Elimination System
NRC - Nuclear Regulatory Commission
NSWC - Naval Surface Warfare Center
NSP - National Aerospace Plane
NSWCDD - Naval Surface Warfare Center Dahlgren Division
NWI - National Wetland Inventory
$N_2O_4$ - Nitrogen Tetroxide
O&M - Operating and Maintenance
OBOD - Open Burn/ Open Detonation
OSHA - Occupational Safety and Health Administration
OSPL - Overall Sound Pressure Level
PARD - Pilotless Aircraft Research Division
PCM - Pulse Coded Modulation
PFRR - Poker Flat Research Range
ppb - parts per billion
ppm - parts per million
R&D - Research and Development
RADTRAC - Radar Tracking System
RARF - Radar Atmospheric Research Facility
RCRA - Resource Conservation and Recovery Act
RfR - Radio-frequency Radiation
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SAR - Specific Absorption Rate
SARA - Superfund Amendments and Reauthorization Act
SCR - Surface Contour Radar
SCS - Soil Conservation Service
SDIO - Strategic Defense Initiative Organization
SEASAT - Sea Satellite
SEL - Single Event Level
SELVS - Small Expendable Launch Vehicle Systems

| | | |
|---|---|---|
| SERC | - | State Emergency Response Commission |
| SIC | - | Standard Industrial Classification |
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| SPCC | - | Spill Prevention, Control, and Countermeasures |
| SQAB | - | Safety Quality and Assurance Branch |
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| TCLP | - | Toxicity Characteristic Leaching Procedure |
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| TOPEX | - | Topography Experiment Satellite |
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| TQM | - | Total Quality Management |
| TRMM | - | Tropospheric Rainfall Measurement Mission |
| TSP | - | Total Suspended Particulates |
| TSS | - | Total Suspended Solids |
| TWA | - | Time Weighted Averages |
| UHF | - | Ultra High Frequency |
| USAF | - | United States Air Force |
| USCG | - | United States Coast Guard |
| USDA | - | United States Department of Agriculture |
| USDI | - | United States Department of Interior |
| USFWS | - | United States Fish and Wildlife Service |
| USGS | - | United States Geological Survey |
| USLSS | - | United States Life Saving Service |
| USN | - | United States Navy |
| USSR | - | Union of Soviet Socialist Republics |
| UST | - | Underground Storage Tank |
| UV | - | Ultraviolet |
| V/C | - | Vehicle/Capacity |
| VDGIF | - | Virginia Department of Game and Inland Fisheries |
| VDHR | - | Virginia Department of Historic Resources |
| VHF | - | Very High Frequency |
| VOC | - | Volatile Organic Compound |
| VPDES | - | Virginia Pollutant Discharge Elimination System |
| WHAFIS | - | Wave Height Analysis for Flood Insurance Study |
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| WOTS | - | Wallops Orbital Tracking Station |
| WSMR | - | White Sands Missile Range |
| WVC | | Wallops Visitor Center |
| WWTP | - | Wastewater Treatment Plant |

# 1.0 INTRODUCTION

## 1.1 ENVIRONMENTAL RESOURCES DOCUMENT FORMAT

This Environmental Resources Document (ERD) has been prepared for the National Aeronautics and Space Administration (NASA) Goddard Space Flight Center (GSFC) Wallops Flight Facility (WFF) located at Wallops Island, Virginia. This Environmental Resources Document follows the standard format of an Environmental Impact Statement (EIS). This Chapter provides an introduction describing the purpose of the Environmental Resources Document, the history of previous Environmental Resources Documents, and a description of Wallops Flight Facility. Chapter 2.0 describes the ongoing activities, and Chapter 3.0 describes the mission. Chapter 4.0 describes the affected environment of Wallops Flight Facility. The chapter is presented in three main categories with resource categories under each. The main categories are: Physical Factors (Land Resources, Energy Usage, Water Resources, Wetlands and Floodplains, Air Quality, Radiation, Noise, Solid Waste, and Regulated Substances); Biological Factors (Biological Resources and Threatened and Endangered Species); and Social and Economic Factors (Socioeconomic Environment and Cultural Resources). Chapter 5.0 follows a format similar to Chapter 4.0 and describes the operations at Wallops Flight Facility that could potentially impact each resource category. In addition, Chapter 5.0 describes recommendations for minimizing impacts and discusses ongoing projects, which have been implemented to minimize impacts of NASA operations. Chapter 6.0 provides a list of preparers and reviewers of this document. Chapter 7.0 lists references.

## 1.2 PURPOSE OF THE ENVIRONMENTAL RESOURCES DOCUMENT

This Environmental Resources Document fulfills the requirements of Title 14 of the Code of Federal Regulations (CFR), Chapter V, Section 1216.319 *Procedures for Implementing the National Environmental Policy Act* (NEPA), stating, "each (NASA) Field Installation Director shall ensure that there exists an environmental resources document describing the current environment at that field installation, including current information on the effects of NASA operations on the local environment. This document shall include information on the same environmental effects as included in an environmental impact statement."

The National Environmental Policy Act, initially passed by Congress in 1969 and most recently amended in 1979, describes the purpose and intent of preparing the National Environmental Policy Act documents. The National Environmental Policy Act outlines the national policy for ensuring that a full environmental review of projects be incorporated into the decision-making process. Under the National Environmental Policy Act, the Council on Environmental Quality defines responsibility and promulgates regulations that guide the National Environmental Policy Act process (40 CFR 1500). An Environmental Assessment (EA) is a concise public document which is prepared for proposed projects to analyze the need for further environmental reviews such as an Environmental Impact Statement. An Environmental Impact Statement is described in the Federal Register as "an action-forcing device" devised to ensure that "the policies and goals defined in NEPA are infused into the ongoing programs and actions of the Federal Government." Both the Council on Environmental Quality (40 CFR 1500-1508) and NASA's specific

guidelines for complying with the National Environmental Policy Act (14 CFR 1216) were considered in the preparation of this document. This Environmental Resource Document differs from an Environmental Impact Statement in that it addresses the ongoing operations of Wallops Flight Facility rather than a proposed project, and can be used as a management and planning tool to assist with ongoing management and planning decisions. The document is to be updated every 5 years to provide the most current and comprehensive environmental information available for Wallops Flight Facility. A frequent update of the Environmental Resource Document also provides a forum for public participation in the evolution of NASA's activities. Public participation is not required for this Environmental Resource Document under 14 CFR Chapter V, Section 1216. However, NASA issued a Notice of Intent (NOI) to prepare the 1994 ERD and conducted public meetings in the fall of 1991 in the local area. The affected environment section of this document provides a baseline of information for the environmental resource categories typically found in an Environmental Assessment or Environmental Impact Statement. Activities or projects which are not included in the Environmental Resource Document "umbrella of on-going operations" (described in Chapter 2.0) may require the preparation of a separate Environmental Assessment or Environmental Impact Statement. The Environmental Resource Document will serve as a reference document for such projects. The *GSFC Environmental Handbook* outlines the procedures for evaluating the need for an Environmental Assessment or Environmental Impact Statement. Information from an Environmental Assessment or Environmental Impact Statement done for projects outside the scope of the current Environmental Resource Document will be incorporated into the subsequent revision of the Environmental Resource Document.

## 1.3 HISTORY OF PRIOR ENVIRONMENTAL RESOURCE DOCUMENT

The Environmental Resource Document has been previously published in 1980, 1990, and 1994 (References 46, 113, 53 respectively). The three previous documents have been reviewed in preparing this Environmental Resource Document and information still pertinent to the current ongoing operations at Wallops Flight Facility is included in this edition.

## 1.4 DESCRIPTION OF WALLOPS FLIGHT FACILITY

### 1.4.1 Location

Wallops Flight Facility is composed of three separate specific areas (Figure 1-1), the Main Base (MB), the Mainland (ML), and Wallops Island (WI), which are in close proximity to each other. Wallops Flight Facility is located in a temperate climate zone at approximately 37° 56' north latitude and 75° 27' west longitude. Wallops Flight Facility is within the political boundaries of Accomack County on the Eastern Shore of the Commonwealth of Virginia. This location is on the Delmarva Peninsula, which is bordered by the Atlantic Ocean on the east, the Chesapeake Bay on the west, and the Delaware Bay and River on the northeast (Figure 1-2). Wallops Flight Facility is approximately 40 miles southeast of Salisbury, Maryland, and 90 miles (145 kilometers) north by northeast of the Tidewater Regional area. Chincoteague Island is approximately 5 miles (8 kilometers) east of the Main Base. The Wallops Flight Facility region, for the purposes of this document, includes a 40-mile (64.4 kilometers) radius with the northern limit in Salisbury, Maryland, and the southern limit in Nassawadox, Virginia.

# *Wallops Land Use*

**Wallops Mainland**

**Wallops Island**

**Wallops Main Base**

**Figure 1-1**
**Wallops Land Use**

Wallops Flight Facility Main Base is composed of approximately 2,230 acres (902.4 hectares). It is bordered on the east by extensive marshland and creeks, which lead into Chincoteague Bay and Chincoteague Inlet. To the north and west, the Main Base is bordered by Mosquito Creek, an estuarine area. The Main Base is bordered on the south and southeast by state routes 175 and 798, respectively.

Wallops Island is approximately 7 miles (11.3 kilometers) long by ½ mile (0.8 kilometers) wide and is surrounded by water. It is comprised of 4,200 acres (1,700 hectares), including the marsh area. Wallops Island borders the Atlantic Ocean on the east, and Chincoteague Inlet on the north. Marshland covers the entire western approach to Wallops Island. The marsh is interlaced with small creeks and is bisected by the Intracoastal Waterway. Wallops Island was joined with Assawoman Island to the south when the inlet between them was closed by a storm in 1986. The inlet was temporarily reopened in 1987, but it remains closed today.

The Mainland area is bordered by extensive marshland to the east, and by farmland to the south, west, and north. This area covers 100 acres (Reference 46).

### 1.4.2 Installation History

In 1672, a patent for 1,450 acres (587 hectares) was issued to John Wallop by King Charles II of England. This patent encompassed what was then known as Kekotank Island, alias Accocomson Island. Patents were reissued in 1682 for 1,800 acres (728.4 hectares) and in 1692 for 1,500 acres (607 hectares), including all of Kekotank Island along with its adjacent waters (Reference 53).

In 1693, John Wallop divided the island, which is now known as Wallops Island, and gave it to his two children; Sarah Wallop received 2,000 acres (809 hectares) and Skinner Wallop, 500 acres (202 hectares). Apparently, Skinner sold four or five parcels of land prior to his death; however, there is no complete record of these transactions (Reference 53).

Sarah married Captain John Watts in 1726, and their two children received 1,000 acres (405 hectares) each upon Sarah's death. This land seems to have remained in the family until it was sold in 1889 along with island acreage to Wesley K. Woodbury of Wrightsville, Pennsylvania. Mr. Woodbury was apparently a trustee for what was known as the Wallops Island Association, and the island was held by various trustees for this association until 1933. The association used the island for hunting, fishing, and swimming. Association members gained access to the island by sailing a small boat across Chincoteague Inlet. In 1933, the Wallops Island Association incorporated and became known as the Wallops Island Club (Reference 53).

The United States Government has had a presence on the island since 1883. In that year, a small amount of land was purchased from the Wallops family by the United States Life Saving Service for a life saving station; the United States Life Saving Service is now known as the United States Coast Guard. Prior to this time, the island was basically uninhabited (Reference 53).

The National Advisory Committee for Aeronautics (NACA) took possession of 85 acres (34 hectares) along the beach for a launch area in 1945. Wallops became the experimental laboratory

or test base for the Pilotless Aircraft Research Division of the Langley Aeronautical Laboratory. On June 27, 1945, the first rocket was launched from Wallops Island. This rocket was used to check tracking station locations and operations, to ascertain the use of Doppler radar, and to gain experience in the actual launch of rockets. Permanent NACA facilities were constructed on the island in 1946 after NACA purchased portions of the island. Today, no privately owned land exists on Wallops Island (Reference 53).

The Main Base area also came down through the Wallops family, with patents in 1664 containing nearly 3,000 acres (1,214 hectares). During World War II, the United States Navy (USN) took over the property and established the Chincoteague Naval Auxiliary Air Station. This Chincoteague Naval Auxiliary Air Station was primarily a training field for naval aviation, but it was also used for ordnance testing (Reference 53).

On October 4, 1957, the Union of Soviet Socialist Republics (USSR) launched a small satellite called SPUTNIK I. Closely following this dramatic event, the USSR launched a 1,100-pound satellite named SPUTNIK II on November 5, 1957. Both these events acted as catalysts for the United States space exploration effort. President Dwight D. Eisenhower signed the Space Act, Public Law (PL) 85-568, on July 29, 1958. This act created NASA and NACA was absorbed into the new agency. NASA was officially given organizational life on October 1, 1958 (Reference 53).

It was during this time that the USN decided to close the Chincoteague Naval Auxiliary Air Station. The fledgling NASA acquired the facility on June 30, 1959, and also acquired the Mainland area. The entire Wallops complex consisting of the Main Base, the Mainland, and Wallops Island became known as the Wallops Station in 1959 (Reference 53).

Access to Wallops Island was initially by boat. In 1959, a causeway and bridge were approved for construction to allow for enhanced access of personnel and materials to the launch areas located on Wallops Island. The causeway and bridge were opened in 1960 (Reference 53).

On December 4, 1959, the Wallops Station made world history when it launched on a suborbital trajectory and successfully recovered "Sam," a Rhesus monkey. This launch tested the design for the Mercury capsule, which was to be the orbiting vehicle for this country's first steps toward manned space flight (Reference 53).

The name of the facility was changed on April 26, 1974, from the Wallops Station to the Wallops Flight Center. The Wallops Flight Center was consolidated with GSFC in October 1981, and the name was changed to the Wallops Flight Facility (Reference 53). The consolidation objectives were to improve the overall effectiveness of the centers through institutional reconfiguration and to focus both centers' resources in their areas of expertise.

Activities expanded during the late 1970's and early 1980's to include management of suborbital projects. Orbital tracking responsibilities were added during the mid-1980's. Since then, Wallops Flight Facility's research has included aircraft drag investigations, heat transfer problem resolution, stability investigations, hypersonic research, space technology development, space

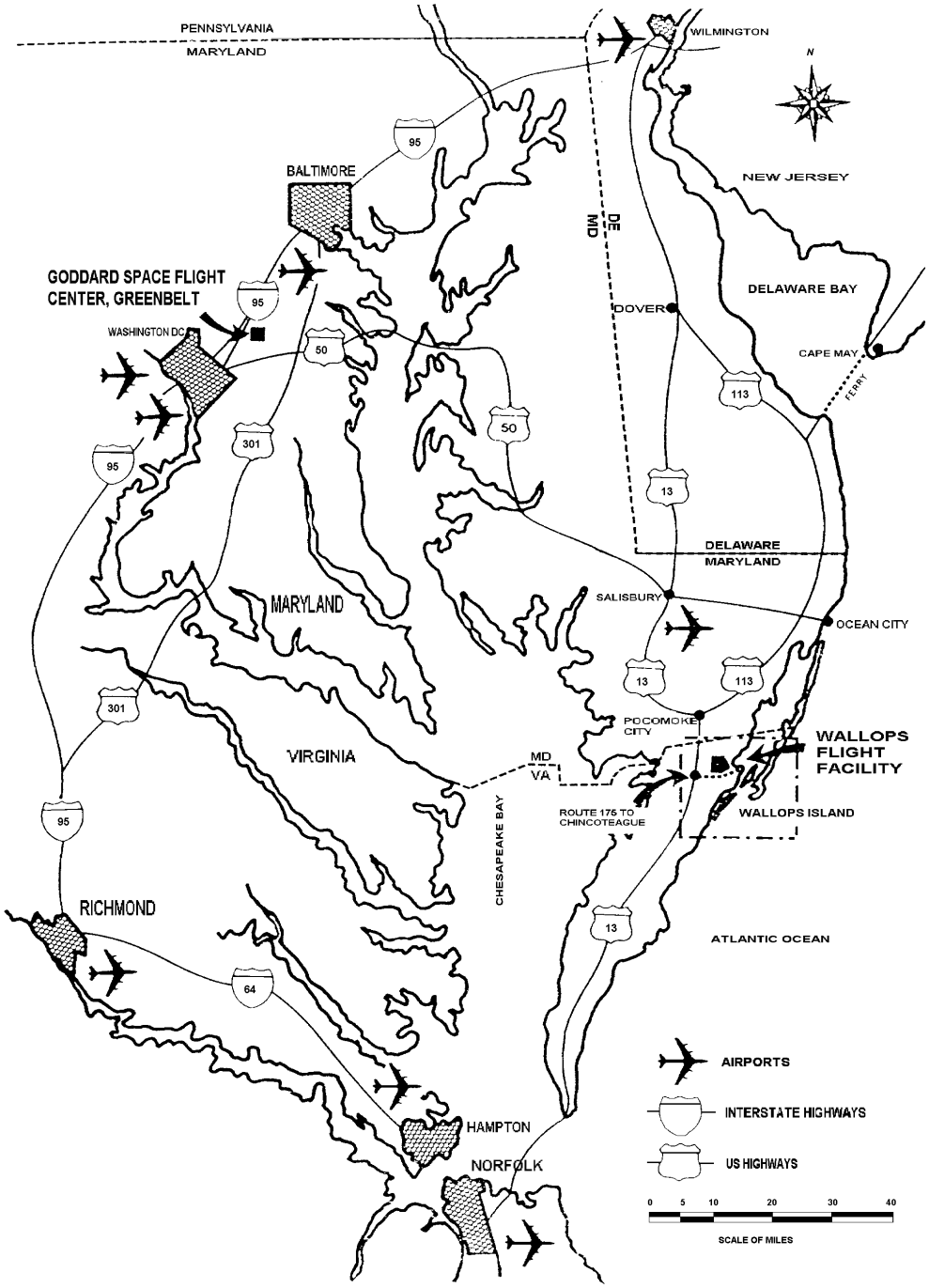



**Figure 1-2**
**Wallops Flight Facility**

science experiments, and scientific experimentation from rocket borne payloads. Wallops Flight Facility also participated in ballistic missile nose cone research, atmospheric and space science experiments on rocket payloads, sounding rocket research and development for the Mercury program, development and scientific launches of the Scout launch vehicle, and management of the NASA Balloon Program. (Reference 53).

In 1997 responsibilities expanded to include Shuttle-based and other small orbital projects. During October of 1998 the Virginia Commercial Space Flight Authority officially inaugurated the Virginia Space Flight Center, a FAA licensed commercial spaceport on Wallops Island.

### 1.4.3 Facilities

#### 1.4.3.1 Buildings and Structures

Main Base facilities include offices, laboratories, maintenance and service facilities, NASA-owned airport, air traffic control facilities, hangars, and aircraft maintenance and ground support buildings. In addition, there are water and sewage treatment plants, rocket motor storage magazines, U.S. Navy administration and housing as well as Coast Guard housing, and other miscellaneous structures.

Several hundred buildings are dispersed throughout the Main Base, the Mainland and Wallops Island (Figures 1-3 and 1-4). The buildings on the Main Base are one to four stories in height with no single, dominant architectural theme. Aircraft hangars and a converted hangar (Building F-10) have metal panel exteriors with typical hangar roofs. The buildings in the E area of the Main Base have been modernized by the addition of foam insulation with a stucco finish applied over the insulation. Many of the Main Base buildings were present in the 1940's when the facility was the Chincoteague Naval Auxiliary Air Station. The operations and maintenance facility and some storage facilities have metal panel exteriors. Buildings around the antenna complex (Buildings N-161, N-162) have concrete-masonry or concrete-steel exteriors. The Wallops Visitor Center building has a steel-masonry exterior (Reference 53).

Mainland and Wallops Island sites are associated with launch activities and Navy training and research activities. Mainland sites include long range radar, communications, and optical tracking installations. The Wallops Island sites include the launch sites, blockhouses, rocket storage buildings, assembly shops, dynamic balancing facilities, tracking facilities, Navy facilities, and other related support structures.

Buildings on the Mainland and the Wallops Island (Figure 1-4) are in an area where a high level of environmental degradation can be expected to occur due to nature (e.g., saltwater, storms, humidity, etc.). The majority of these buildings are concrete block with concrete parging. Some of the newer buildings and a few of the refurbished buildings have prefabricated metal panels. Blockhouses are constructed of reinforced concrete (Reference 53). Many of the buildings at the facility have exceeded their design life. Extensive efforts have been made to rehabilitate buildings, both interior and exterior, and building upgrades are continuing.

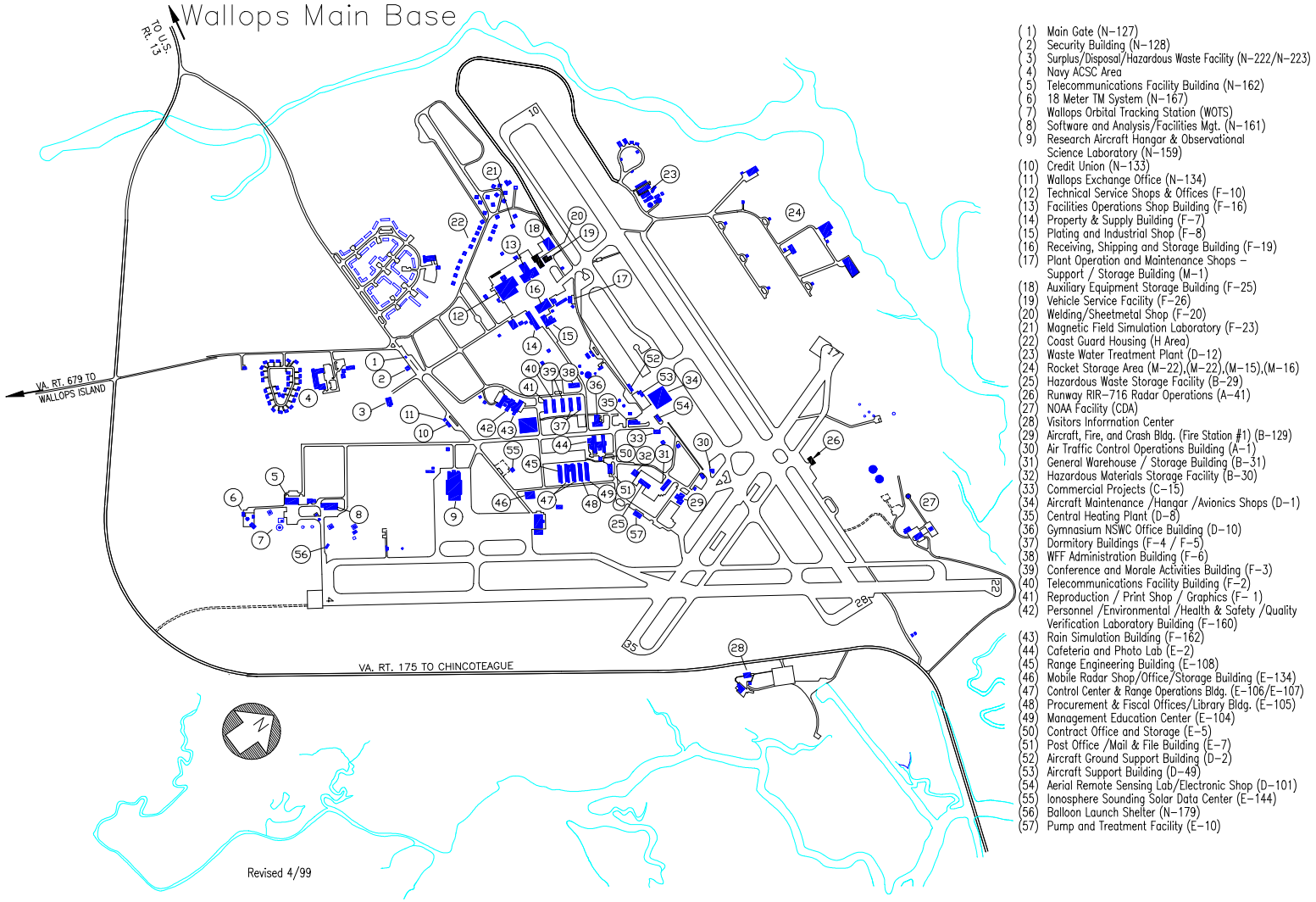



**Figure 1-3**
**Wallops Main Base**

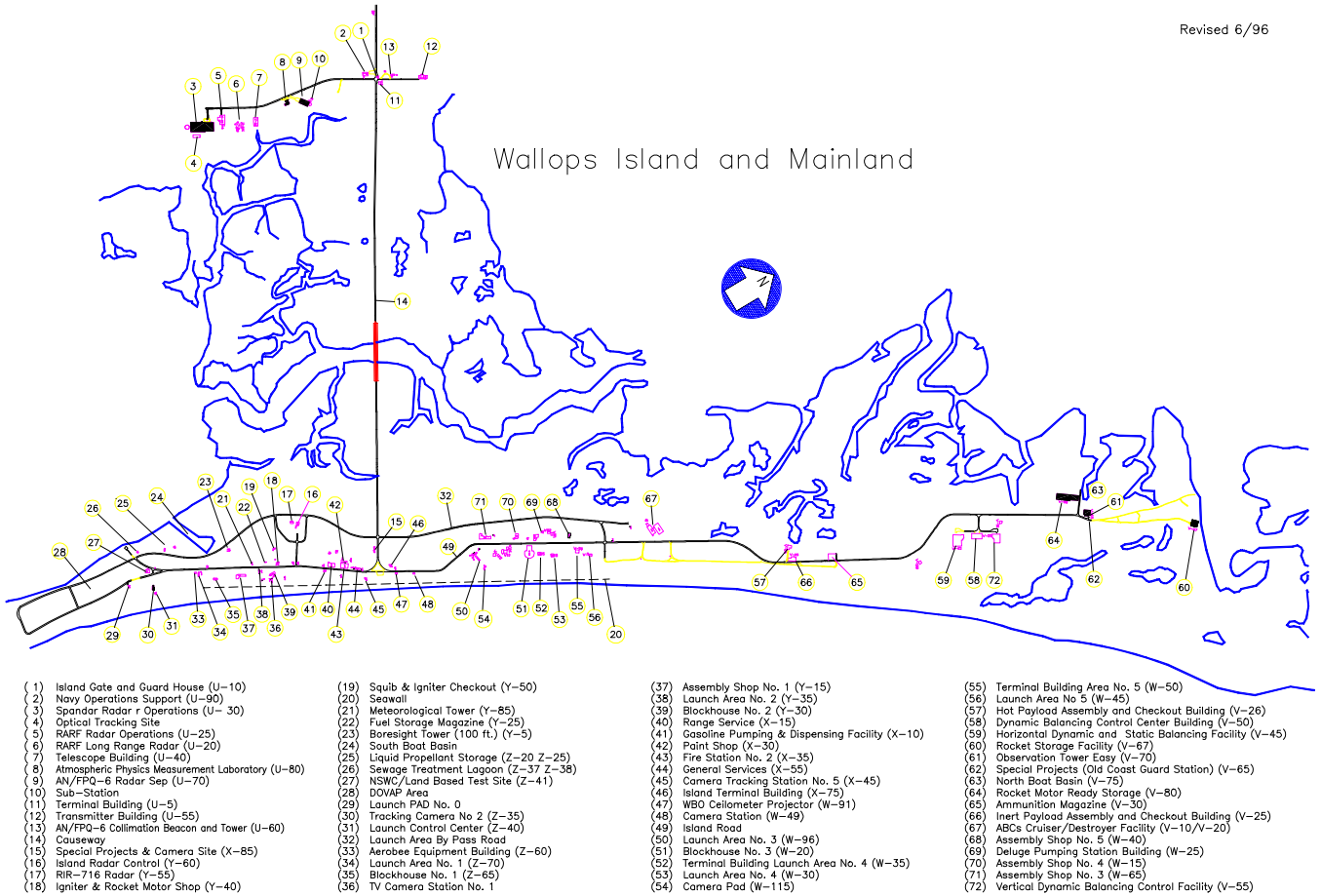



**Figure 1-4**
Wallops Mainland and Wallops Island

#### 1.4.3.2 Research and Development Laboratories/Facilities

Wallops Flight Facility maintains a research airport consisting of three runways, communications and radar tracking systems, as well as, other support facilities and services for aeronautical research. NASA contractor personnel provide air traffic control services from the control tower in Building A-1 between the hours of 7:00 AM and 5:30 PM, Monday through Friday. The Wallops Fire Department provides advisory radio coverage during the air traffic controllers, off-hours.

Hangar areas for aircraft and laboratory space for research teams are available in Building N-159. The Wave Tank in Building N-159 on the Main Base is used for wind-wave-current studies. The Balloon Laboratory in Building D-101 performs materials testing and component fabrication in support of the NASA Balloon Program. Payload integration and testing for the Ultra Long Duration Balloon project occurs in Building C-15.

The Sounding Rockets Program consists of Payload Integration and Environmental Testing Laboratories. The Payload Integration Laboratory in Building F-10 includes facilities for complete mechanical or electrical payload assembly and testing. The laboratory includes telemetry ground stations and clean room facilities. The Environmental Testing facilities in Building F-10 include the static loads facility, rotary accelerator, spin test facility, electromagnetic shakers, thermal vacuum chamber, physical properties determination, static and dynamic balancing, and magnetic calibration facility. Building F-10 also houses a machine shop to provide support in fabricating sounding rocket payloads and launch vehicle components, as well as general facility maintenance.

The Calibration Laboratory in Building F-160 performs repair and calibration of test instruments. The Chemical Laboratory, also in Building F-160, is the primary source for chemistry tests in support of the operation of water treatment, wastewater treatment, and testing related to research activities.

Facilities on Wallops Island are primarily dedicated to the preparation of launch vehicles and payloads. Facilities on the island include launch vehicle assembly shops, launch pads and launchers, launch blockhouses, radar-tracking facilities, optical tracking facilities, wind towers, payload checkout and assembly areas, as well as, storage areas. A dynamic balance facility in Building V-50, on Wallops Island, houses spin testing and balancing equipment.

#### 1.4.3.3 Utilities

Electric power is supplied to the Wallops Flight Facility by the Wattsville substation of Conectiv Power. Some critical operations are supported by backup electrical generators.

A variety of communication systems support Wallops Flight Facility operations. These systems include a cable plant and associated systems, microwave links, closed-circuit television systems, command systems, high-speed data circuits, and the Wallops NASA Communications System (NASCOM) terminal.

The Main Base central boiler plant provides steam generation for areas D, E, F, N-159, and, C-15. Heating in other areas of the Main Base is provided by local fuel-oil burning boilers, heat pumps, or other similar equipment. All buildings on the Mainland and Wallops Island are heated by individual boilers. The fuel sources are situated locally.

Water for the Main Base is supplied from 5 on-site wells interconnected in a water supply piping system that is treated and feeds the 500,000 gallon (1,892,706 liters) ground-level storage reservoir (D-45). Water from this reservoir is pumped to the 150,000 gallon (567,812 liter) elevated storage tank (F-161), which supplies the distribution system. The chlorination plant has a capacity of approximately 1,000,000 gallons per day (gpd) (3,785,412 liters per day [lpd]). The ground water withdrawal permit from the Virginia Department of Environmental Quality allows withdrawal of up to 300,000 gpd (1,135,624 lpd). The Main Base distribution piping system is primarily ductile iron.

Potable water for the Mainland and Wallops Island is supplied from two wells with a potential capacity of 400,000 gpd (1,514,165 lpd). Two 150,000 gallon (567,812 liter) elevated storage tanks (X-45 and W-55), one 100,000 gallon (378,541 liters) elevated storage tank (V-90) on Wallops Island and an 80,000 gallon (302,833 liter) ground-level reservoir on the Mainland (U-49) are the operational storage facilities. The chlorination plant, located next to the pump house (U-50), has a capacity of approximately 175,000 gpd (662,447 lpd).

The Main Base is served by a system of gravity sewers connected to a Federally Owned Treatment Works (FOTW). The new plant, adjacent to the old plant, connects to the existing sewer lines and offers a treatment capacity of 300,000 gpd (1,135,624 lpd). The Wallops Visitor Center is served by a separate dedicated septic system. Sewage on the Mainland discharges to septic tanks. Sewage at Wallops Island is collected by gravity sewers and transported by a force main to the Main Base, with the exception of five sites on the north end that make use of septic systems.

Storm drainage on the Main Base is provided by side ditches along streets without curbs and gutters, drop inlets on curbed streets, and cross culverts to provide drainage to natural waterways. On the Mainland, storm drainage is generally handled by overland flow to the Bay. On Wallops Island, storm drainage is handled by isolated cross culverts on the existing north-south bypass road. Two storm water pumps serve the dike system surrounding Buildings Y-55 and Y-60.

Fuel is stored in five areas on the Main Base. The service station area contains one 10,000 gallon (37,854 liter) tank each for diesel fuel and automotive gasoline. The Wallops Flight Facility owns and operates 49 aboveground storage tanks and 22 underground storage tanks of various sizes located throughout the facility. The total fuel storage capacity at Wallops Flight Facility, including partners, is summarized in Table 1-1. The aboveground storage tanks can store a maximum of 333,910 gallons (1,263,987 liters) of fuel. The underground storage tanks are capable of holding roughly 196,695 gallons (744,572 liters) of fuel. The underground storage tank fuel is primarily used for fueling mobile sources (motor vehicles and aircraft) and some heating for buildings. Mobile fueling trucks have a combined carrying capacity of 30,400 gallons (115,077 liters).

**TABLE 1-1**
**WFF FUEL STORAGE SUMMARY**

| Oil Commodity | Storage Type | | | Total Storage Capacity (gallons) |
|---|---|---|---|---|
| | AST | UST | Mobile | |
| #2 Fuel Oil | ✓ | ✓ | | 114,980 |
| #6 Fuel Oil | ✓ | | | 250,000 |
| JP-5 and JPTS Jet Fuel | | ✓ | ✓ | 144,000 |
| Diesel Fuel | ✓ | ✓ | ✓ | 13,950 |
| Gasoline | | ✓ | ✓ | 10,300 |
| Kerosene | ✓ | | | 275 |
| Off-spec. Fuel | | ✓ | | 10,000 |
| Waste Oil | | ✓ | | 16,580 |

At Wallops Island, liquid propellant is stored, when necessary, in Buildings Z-15, Z-20, and Z-25. Automotive gasoline is ferried by fuel truck from the Main Base on a regular daily schedule to service the vehicles used predominantly on Wallops Island and the Mainland. Heating oils are stored in individual storage tanks at the points of use.

Compressed air is provided at the Main Base and on Wallops Island by local systems at the point of use.

#### 1.4.3.4 Transportation

Six miles of state maintained road connect the Main Base and Mainland. NASA owns a paved road, bridge, and causeway that connect the Mainland and Wallops Island. The facilities provide the only land link to Wallops Island and are a critical part of the NASA infrastructure. Hard surface roads maintained by NASA connect the facilities located on Wallops Island and the Mainland.

Wallops Flight Facility organizations own and operate a variety of vehicles including: sedans, vans, trucks and bicycles for land transportation; and a fleet of two program support and one mission management aircraft for air transportation. Six boats owned by the Marine Science Consortium (MSC) are maintained at the boat basin along VA Route 175 at Wallops Flight Facility.

#### 1.4.3.5 Shoreline Protection Facilities

A system of shore protection works has been constructed along a 22,400 foot (6,826 meter) reach of Wallops Island, in an effort to protect the launch facilities from erosion damage. The primary protective features consist of a stone and rip-rap seawall extending from Building V-24 southward to Building Z-40 and a revetment curving from the end of the seawall around Launch Pad 0-B.

### 1.4.3.6 Plant and Personnel Protection

Fire Station No.1 (B-129) is centrally located and accessible to all areas of the Main Base. Its location adjacent to the airfield provides ready access in the event of aircraft accident. Crash, fire, and rescue vehicles include three all-wheel-drive pump trucks designed for airport response. Fire Station No. 1 is also equipped with two structural fire trucks, a water/foam tanker, an ambulance, and one light duty rescue truck. The Main Base has a central Fire Alarm Reporting System, located in Building B-129. All major buildings on the base are equipped with fire detection or reporting systems, depending on the classification of the structure. Existing developed areas and facilities are served by strategically located fire hydrants. A 500,000-gallon (1,892,706 liter) ground-level reservoir and four 2,000 gpm (7,570 lpm) diesel driven fire pumps in Building D-4 provide water reserve for fire fighting purposes. The Main Base is provided with portable fire extinguishers that are located on each floor of every building and storage area.

Fire Station No. 2 (X-15) located on Wallops Island services all areas of Wallops Island and Mainland. Station No. 2 is equipped with two engines, one crash unit, and an ambulance. Launch areas, rocket storage areas, and buildings have access to an emergency phone number. An Automatic Instrument Alarm System is used in the liquid fuel storage area. Wallops Island buildings are supplied with a full complement of portable fire extinguishers.

Medical facilities are located in Building F-160 on the Main Base. These facilities house stress, visual, coronary, and pulmonary testing equipment.

### 1.4.3.7 Other Facilities

Dormitories in Buildings F-4 and F-5 are available to researchers and other visiting personnel. Coast Guard and Navy also have personnel housing facilities at Wallops Flight Facility.

The Management Education Center (MEC) in Building E-104 is an agency-wide training facility to support human development programs. The Wallops Visitor Center provides guided tours, video presentations, lectures and exhibits, model rocket demonstrations, and maintains a gift shop and permanent exhibits.

The National Oceanic and Atmospheric Administration (NOAA) provides weather information to the Nation and the world. Currently, 5 antennae, 12 dish antennae, and associated equipment track, monitor, and command 9 weather satellites 24 hours per day.

The U.S. Navy operates and maintains three facilities on the northern half of Wallops Island. The AEGIS Facility provides the system and training of personnel for development and evaluation of the AEGIS Combat System in Buildings V-10 and V-20. Testing and operations are performed at the Ship Self Defense System Facility in Building V-24. These facilities operate under the command of the Surface Combat Systems Center.

# 2.0 DESCRIPTION OF INSTALLATION AND OPERATIONS

## 2.1 INTRODUCTION

Wallops Flight Facility consists of three separate sections of real property --the Main Base, Mainland, and Wallops Island --comprising a total of more than 6,500 acres (26.3 square kilometers) and 120 major, NASA, facilities valued at more than $150 million. NASA employs approximately 900 civil service and contractor employees with an annual payroll of more than $30 million. Partner organizations, like the U.S. Navy, employ approximately 500 people.

### 2.1.1 Wallops Flight Facility Mission

Wallops Flight Facility's mission is to further scientific, educational, and economic advancement by supplying facilities and expertise to enable frequent flight opportunities for a diverse customer base. Wallops Flight Facility is a national resource for providing low-cost integration and operation of suborbital and small orbital payloads that support space based research focused on Earth and its environments.

#### 2.1.1.1 Wallops Test Range

The Wallops Test Range consists of a launch range, an aeronautical research airport and associated tracking, data acquisition, and control instrumentation systems. An orbital tracking station operates continuously in support of several scientific satellites. Wallops Flight Facility aircraft, used as aerial platforms, support the development of remote sensing techniques and instruments to measure ocean atmospheric parameters and to conduct scientific missions. Scientists and engineers from NASA, other government agencies, colleges and universities, private industry, and the worldwide scientific community use Wallops Flight Facility's assets and services.

#### 2.1.1.2 Suborbital Program

The Suborbital and Special Orbital Projects Directorate, located at Wallops Flight Facility, leads NASA's Suborbital and Special Orbital Programs. Sounding Rockets, balloons, and aircraft are used in NASA programs investigating space science, earth science, advanced technologies, and aeronautical research. Missions are conducted at both domestic and foreign sites. New technologies including the 100-day balloon capability, a part of the Ultra Long Duration Flight project, are being integrated into the program. Wallops Flight Facility provides support for mission and payload management, engineering, payload design and development, launch vehicle systems, attitude control systems, and payload recovery systems, along with facilities for fabrication, payload integration, and environmental testing. Code 800 management includes responsibility for the activities at White Sands Missile Range and Poker Flat Research Range, the NASA Balloon Program at the National Scientific Balloon Facility in Palestine, Texas, and sites in New Mexico. This ERD only covers activities launched from Wallops Flight Facility. Environmental issues at other locations are covered in separate documentation. NASA Sounding

Rockets Program activities are covered in a separate document entitled, *Supplemental Environmental Impact Statement for the NASA Sounding Rockets Program,* dated 1996.

#### 2.1.1.3 Goddard Space Flight Center at Wallops Flight Facility

Wallops Flight Facility is at the center of NASA's suborbital and special orbital programs and is managed and operated by GSFC's Suborbital and Special Orbital Projects Directorate (Code 800). The GSFC Earth Sciences Directorate (Code 900) maintains an Observational Science Branch (Code 972) at Wallops Flight Facility which conducts space and earth science activities typically involving remote sensing. The Applied Engineering and Technology Directorate (Code 500) provides engineering support for Wallops' missions. The Flight Projects Directorate (Code 400) provides ground network support through the Ground Network Project (Code 452). The Management Operations Directorate (Code 200) provides support through the Environmental and Security Office (Code 205), the Procurement Branch (Code 218), the Facilities Management Branch ( Code 228), the Logistics Team (Code 231), the Library Information Services Branch (Code 292), the Technical Information Services Branch (Code 293), and the Information System and Advanced Technical Branch (Code 296). Other elements of GSFC are located at Wallops Flight Facility to support NASA functions. Figure 2-1 shows NASA's GSFC organizational elements located at Wallops Flight Facility.

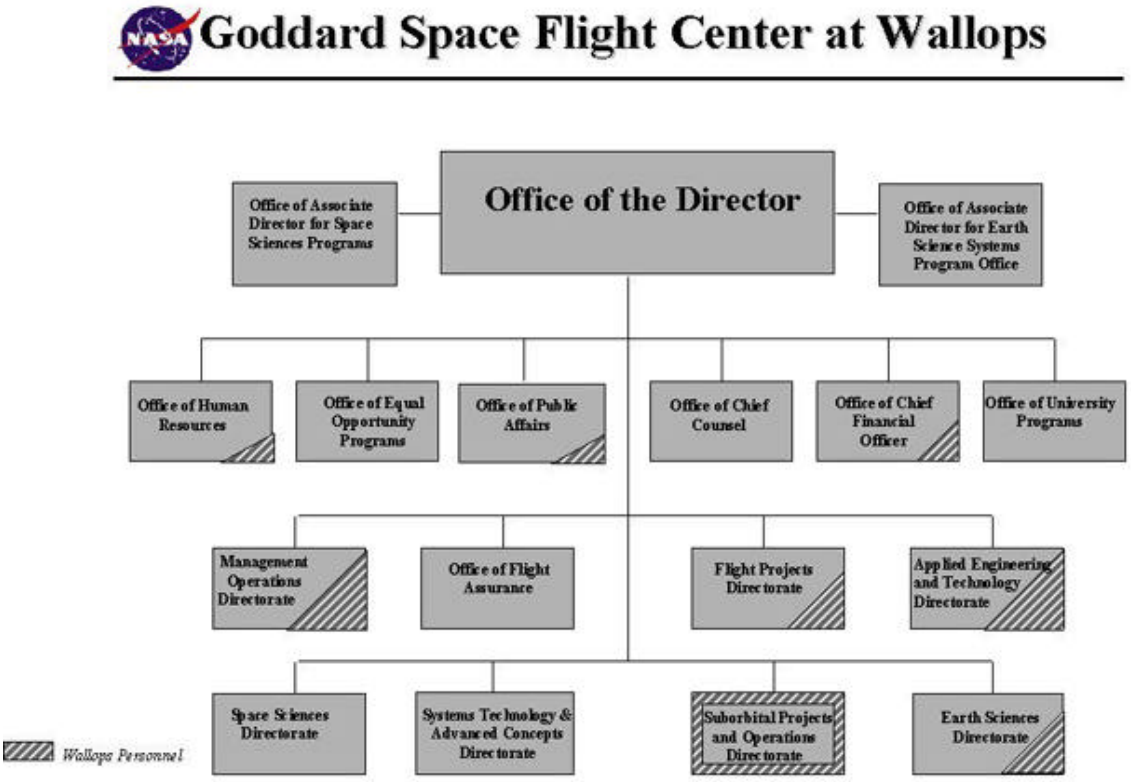



**Figure 2-1**
**GSFC Organizational Elements at Wallops Flight Facility**

#### 2.1.1.4 Other User Organizations and Support Issues

Wallops Flight Facility serves other organizations with a variety of interests. These organizations utilize Wallops Flight Facility on an "as needed" basis for operational support and draw on Wallops Flight Facility services.

Contractors perform many of the functions described in this chapter. The work performed by NASA contractors is closely monitored and conforms to local, State, and Federal Government health, safety, and environmental standards.

Wallops Flight Facility is comparable in many respects to a self-supporting independent community. Wallops Flight Facility's self-sustaining services and utilities include: fire and security protection, water and sewage services, trash collection, roads maintenance, street lighting, electrical services, aircraft services and operations of a library, health clinic, gymnasium and cafeteria. Many of the environmental concerns of a small community apply to Wallops Flight Facility.

### 2.1.2 Wallops Flight Facility Partners

Wallops Flight Facility shares its resources with several partners, as follows.

#### 2.1.2.1 Naval Surface Combat Systems Center

The AEGIS facility provides engineering development and evaluation of components of the AEGIS combat system and the training of personnel. Engineering and training facilities are located on the northern half of Wallops Island in Buildings V-10 and V-20. Eighty-five Navy, 38 civil service, and 200 contractor personnel are employed. Housing and administrative support are located at the Main Base.

**Figure 2-2**
**Ship Self Defense System Facility**

The Ship Self Defense System Facility, located in Building V-24, conducts testing and evaluation operations that are separate from the AEGIS Facility testing, but crucial for the AEGIS combat system. Eleven civil service personnel and 16 contractors are employed at Building V-24. Both facilities are combined under the command of the Surface Combat Systems Center.

#### 2.1.2.2 National Oceanic and Atmospheric Administration (NOAA)

The NOAA National Environmental Satellite Data Information Service Command and Data Acquisition station provides 24-hour per day weather satellite data to the nation and the world. The NOAA complex of antennae and buildings is adjacent to the northeast edge of the Main Base. The NASA Wallops Orbital Tracking Station, located in Building N-162, provides backup to some of the of Command and Data Acquisition functions.

#### 2.1.2.3 Coast Guard

The U.S. Coast Guard maintains housing units west of the Main Base Entrance for personnel assigned to the Chincoteague station.

#### 2.1.2.4 The Virginia Commercial Space Flight Authority

**Figure 2-3**
**Virginia Commercial Space Flight Authority Launch Pad**

The Virginia Commercial Space Flight Authority is responsible for the development and operation of the Virginia Space Flight Center, a FAA licensed commercial spaceport at Wallops Island. The Virginia Space Flight Center provides facilities and services for commercial launches of payloads into space. Activities include launch vehicle and payload preparation, integration and testing, prelaunch operations, launch range integration, and launch and postlaunch operations. One state employee and five contractors are employed at this center.

## 2.2 PROJECT ACTIVITIES

The focus of project activities includes sounding rockets support, test range operations, airport operations, aircraft remote sensing, tracking operations, and data operations. Test range operations include the launching of sounding rockets, target and test rockets, Small Expendable

Launch Vehicles, and small balloons. Airport activities encompass the operation of project aircraft and the use of specialized airport instrumentation and runways for experimental activities. Tracking and data operations include the design, development and operation of a wide variety of tracking, communications, telemetry, optical, meteorological, and specialized instrumentation.

### 2.2.1 Total Range Activities

Table 2-1 shows a summary of projected annual Wallops Flight Facility range activities for Fiscal year 1999 and 2000.

**TABLE 2-1**

***SCHEDULED WALLOPS FLIGHT FACILITY TEST RANGE OPERATIONS***

| | **NASA** | | **Other Agencies** | |
|---|---|---|---|---|
| | 99 | 00 | 99 | 00 |
| Research Rockets | 7 | 4 | - | 1 |
| SELVS & Pegasus | - | - | - | 1 |
| Target/Drones/Decoy Missiles | - | - | 14 | 10 |
| Test Rockets | 20 | 20 | - | 2 |
| Small Balloons | 90 | 90 | - | - |
| STS/ER/Satellite Tracking | 2 | 7 | - | - |
| Aeronautical Research/ Aircraft Tracking Operations | 4 | 3 | - | - |
| Airborne Science | 5 | 5 | - | - |
| National Weather Service Balloons (2/day, 365 day/year) | - | - | 730 | 730 |

### 2.2.2 Launch Activities

#### 2.2.2.1 Wallops Flight Facility Launch Range

The Wallops Flight Facility launch range includes Wallops Island and extends out into the Atlantic Ocean using the surface area and airspace above to conduct flight operations. The principal Wallops Island facilities are those required to process, qualify, and launch solid rocket boosters carrying scientific payloads on suborbital or low Earth-orbit trajectories. Support facilities include: launch pads, launchers, blockhouses, booster preparation and payload qualifying buildings, dynamic balancing equipment, wind measuring devices, communications and control instrumentation, TV and optical tracking stations, surveillance and radar tracking units, and other facilities. The launch areas are located on the southern half of Wallops Island, which includes the facilities mentioned previously. Additional special use facilities are located on the northern portion of Wallops Island.

Figure 1-4 shows Wallops Island and facility locations. Occasionally, ground-based scientific equipment that requires isolation from other activities is located on the northern half of the island, temporarily.

The primary mission for the Wallops Flight Facility launch range is to provide a safe and efficient site for conducting NASA sounding rockets operations and an Atlantic Coast base for launching rockets for other government and commercial organizations. Facilities on Wallops Island are used, as required, to support other NASA science and research programs that involve the use of rockets or balloons to carry instruments to desired altitudes. Additionally, the launch range is used cooperatively for rockets and non-rockets programs. Typical additional programs include: VANDAL, a high-speed target missile for the Naval Air Warfare Center/Aircraft Division; rockets for the Department of Defense Ballistic Missile Defense Organization; and full-scale aircraft development programs for the Naval Air Warfare Center/Aircraft Division.

#### 2.2.2.2 NASA Sounding Rockets Program

The NASA Sounding Rockets Program, managed by the Sounding Rockets Programs Office (Code 810), provides overall management of sounding rockets flight projects, which carry research payloads with scientific instruments to altitudes ranging from 30 to 600 miles (50 to 950 kilometers). Scientific data is collected and returned to Earth by telemetry links. Parachutes are frequently used to recover the instruments for reuse. High-altitude parachutes are occasionally used to retard descent velocity extending the time the experimenters have to gather data at high altitudes.

Figure 2-4 depicts the sounding rocket, Terrier Malamute, demonstrating the relative size differences between typical sounding rockets, better known rocket systems, and an average human.

Wallops Flight Facility provides engineering support through the NASA Sounding Rocket Operations Contract (NSROC) for the NASA Sounding Rockets Program including feasibility studies, payload design and development, vehicle engineering, attitude control systems engineering, payload recovery systems engineering, and test evaluation engineering.

Scientific mission requirements determine the particular type of rocket used to deliver a specific payload. Criteria evaluated include payload weight, size, and trajectory. The rockets are matched to meet the scientific requirements of that project.

Currently, there are sixteen types of sounding rocket launch vehicle systems in the inventory (See Figure 2-5. Note: this figure does not include the meterological rocket, the Super Loki Dart.) The weight of payloads for these launch systems ranges from 500 to 2,500 pounds (227 to 1,134 kilograms). Each launch vehicle system provides unique weight and altitude performance requirements for various experiments.

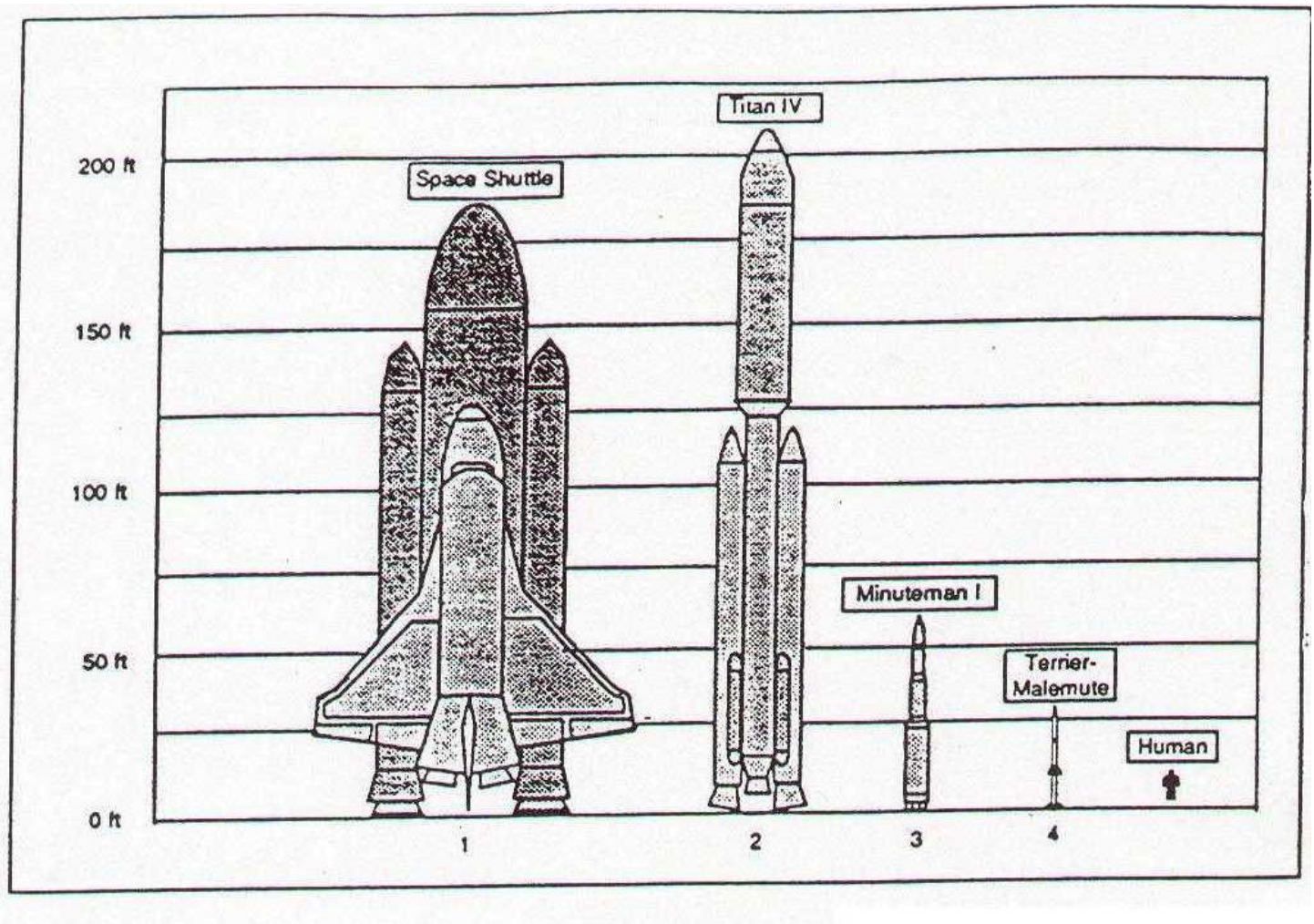



**Figure 2-4**
**Launch Vehicle Comparison**

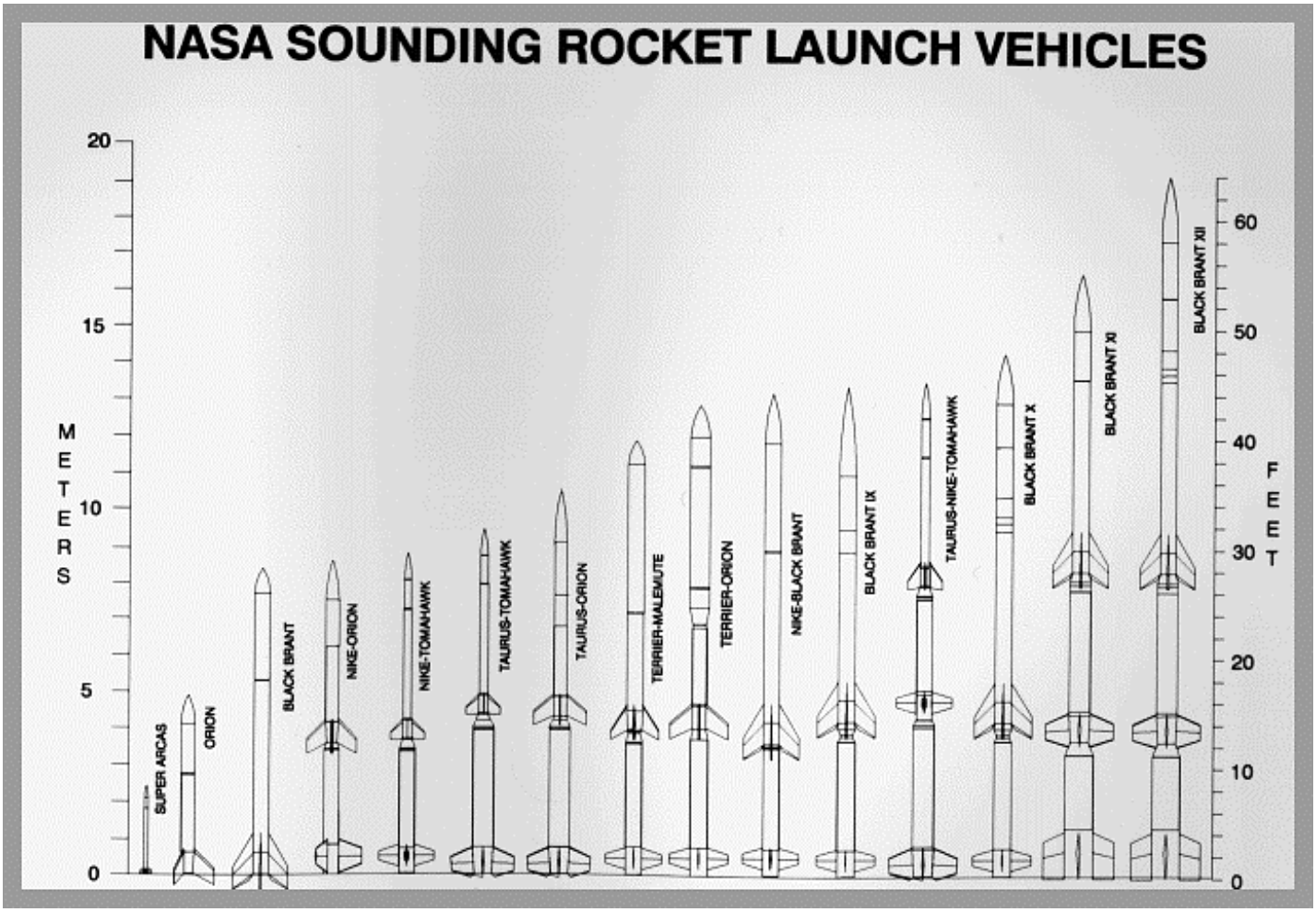



**Figure 2-5**
**NASA Sounding Rockets Launch Vehicles**

The NASA Sounding Rockets Program has the flexibility and capability to respond quickly to scientific requirements with launch operations practically any place on Earth using either permanent or mobile range facilities. Figure 2-5 shows the current NASA sounding rockets launch vehicles that are flown from Wallops Flight Facility.

As technological and scientific advancements increase, the NASA Sounding Rockets Program will require the flexibility to meet research demands. It is anticipated that future progr ams will require increases in payload weight, rockets, and rocket motor capacities.

The NASA Sounding Rockets Program primarily operates for NASA, but serves other government agencies, universities, industry, and foreign countries as well. Environmental concerns related to the NASA Sounding Rockets Program are covered in the separate Final *Supplemental Environmental Impact Statement for the NASA Sounding Rockets Program,* dated 1998.

#### 2.2.2.3 Other Rocket Programs

In addition to NASA sounding rockets launch activities, the Wallops Flight Facility Test Range supports launches from a variety of sources. Scientists and engineers from other Federal agencies, colleges and universities, private industry, as well as, foreign countries use the facilities and services of the Wallops Flight Facility Test Range. The Department of Defense periodically launches rockets from Wallops Island.

Vandal and other Naval Air Warfare Center target vehicle activities continue to be conducted from the northern launch pads, while larger launches are conducted from the south end of Wallops Island. The Virginia Commercial Space Flight Authority has completed construction of a new launch pad at area "0" in preparation for commercial launches beginning in year 2000.

The NASA Small Expendable Launch Vehicle Systems Program supports the Pegasus air dropped launch system. Pegasus is a three staged, solid rocket motor launch vehicle designed to be launched from aircraft. Pegasus was developed by Orbital Sciences Corporation and Her cules Aerospace Corporation to satisfy the launch need for small mass and volume payloads required by the Department of Defense and other users. The Atlantic coast launch in February 1993, of a Pegasus with a Brazilian remote sensing satellite was controlled from Wallops Flight Facility. Commencing in mid-1994, Orbital Sciences Corporation launched Pegasus vehicles using an L-1011 aircraft with flight origin and control from Wallops Flight Facility. Pegasus vehicles continue to be launched and controlled from Wallops Flight Facility. Environmental impacts from proposed Pegasus activities at Wallops Flight Facility are covered in separate NEPA documentation entitled, *Environmental Assessment for the Pegasus Expendable Launch Vehicle Program,* dated September 1993.

#### 2.2.2.4 NASA Balloon Program

Large scientific balloons carry scientific payloads of up to 5,000 pounds (2,300 kilograms) to an altitude of 25 miles (40 kilometers). They are capable of traveling at lower altitudes than sounding rockets and satellites, and can carry laboratory equipment that measures the lower atmospheric layers. The duration of these balloon flights can be for hours or even days. The

balloons are made of a thin polyethylene material that is inflated with helium to lift the payload. Approximately two balloon projects are launched from Wallops Flight Facility each year. Balloon flights are managed by the Balloon Program Office (Code 820). Many technical features related to balloon payloads and technology are designed and tested at Wallops Flight Facility. Most balloon projects are launched at other locations around the world.

### 2.2.3 Meteorological Operations

Wallops Flight Facility collects, displays, stores, and disseminates meteorological data. Data is collected from various sources including surface observations, weather radar, lightening detection systems, and an ionosphere sounder. Meteorological operations involve the launch of weather balloons and small meteorological rockets. The Range and Mission Management Office (Code 840) is responsible for the operation of meteorological systems and facilities.

### 2.2.4 Aeronautical Research

The Wallops Research Airport is a unique NASA asset and one of the major elements of the Wallops Test Range. By virtue of its remote location, controlled airspace, special runway surfaces, precision data tracking, instrumentation, differential global positioning system, and other technical attributes, this facility has provided NASA a means to serve the worldwide aeronautical research community for many years.

Aeronautical research at Wallops Flight Facility includes terminal area operations, full scale aircraft development, jet engine spray ingestion studies, aircraft breaking tests under simulated heavy rain conditions and ongoing NASA/FAA/United States Air Force (USAF) runway friction and tire test performance studies.

Research activity at the Wallops Airfield is expected to continue at about the same level for the next several years. Table 2-2 provides an overview of anticipated aeronautical research activity.

**TABLE 2-2**
**PROJECTED AERONAUTICAL RESEARCH ACTIVITY**

| | Weekly Frequency | |
|---|---|---|
| **Aeronautics Program** | **1999** | **2000** |
| Runway Friction | - | - |
| Ground Vehicle Tests | 3 | 1 |
| Aircraft Braking | 1 | 1 |
| Engine Water Injection | 1 | 2 |

### 2.2.5 Airborne Earth Sciences Research

Some of the Wallops Flight Facility aircraft are used as aerial research platforms for scientific missions. Missions are conducted locally, regionally, and globally. Wallops Flight Facility also makes use of a P-3 aircraft with upward and downward viewing ports. These instruments are used for conducting oceanographic and glacier research missions. The P-3 turboprop aircraft

carries scientific payloads of more than 10,000 pounds (4,535 kilograms) and is frequently deployed to foreign countries. Missions, in foreign countries, are flown beneath satellites to study scientific phenomena peculiar to specific sites.

The scientific groups that use the Wallops Flight Facility aircraft as research platforms come from several NASA field centers, other government agencies, the academic community, and foreign countries.

### 2.2.6 Space and Earth Sciences

The specialized skills available at Wallops Flight Facility are used to identify, plan, and conduct scientific studies related to NASA Earth Science programs. The Observational Sciences Branch (Code 972) manages the majority of space and earth science activities at Wallops Flight Facility. A description of some of the current research programs follows.

#### 2.2.6.1 Atmospheric Dynamics

These studies are primarily aimed at increasing the accuracy of measurements used in weather forecasting. Rockets and balloons are regularly launched at Wallops Flight Facility to confirm the calibration and validity of pressure, dew point, wind speed, and temperature measurements. These rockets and balloon measurements also provide validation of data taken by meteorological satellites. The measurement profiles are compared with satellite readings to determine whether satellite measurements have changed over time due to sensor aging or failure. Sensor correction and measurements quality studies are made by Wallops Flight Facility. This information helps ensure the compatibility and accuracy of measurements made by different rockets, balloons, and satellite instruments throughout the world. In addition, atmospheric behavior and structures can be studied by these methods. In cooperation with other investigators, research is conducted on the interactions between atmospheric electricity and chemistry. The results of this work increase understanding of the complex nature of Earth's atmosphere.

#### 2.2.6.2 Atmospheric Optics

Experimental and theoretical studies in atmospheric optics increase understanding of how light interacts with the atmosphere. Processes that occur in the air on Earth receive the most attention, but atmospheric interactions on other planets are also of interest. Programs include laboratory measurements of the scattering and absorption of light by the molecules and aerosols that make up an atmosphere. A parallel program develops mathematical models of these processes. Through these projects atmospheric constituents are measured. For example, ozone and nitric oxide, through their unique interactions with light, are now measured remotely from aircraft and spacecraft.

#### 2.2.6.3 Ocean Physics

Wallops Flight Facility studies ocean physics to monitor and measure important and diverse variables like ocean wave height and ocean biological activity. New instruments enable measurements to be made through remote sensing of the oceans by aircraft or satellites. These

instruments make direct measurements or are used to acquire complimentary data. The two basic study areas of ocean physics are microwave altimetry for ocean surface studies and ocean color for ocean biology studies.

#### 2.2.6.4 Microwave Altimetry

Microwave altimetry includes research to determine the average sea surface height around the globe, as well as, small-scale variations caused by currents or effects of gravity. Investigations also determine ocean surface currents from satellites and aircraft and measurements of ocean surface wave structure. Altimeters also measure land topography. Complimentary instruments precisely measure the location of relative and geocentric positions of well-marked land points. Wallops Flight Facility has developed spacecraft altimeters flown on the Geostationary Operational Environmental Satellite (GEOS-3) in 1972, on the Sea Satellite (SEASAT-1) in 1978, and currently on the Ocean Topography Experiment Satellite (TOPEX), and on the Mars Observer Lander Satellite (MOLA). The Surface Contour Radar is another Wallops Flight Facility research instrument that is flown on the Wallops Flight Facility P-3 aircraft.

#### 2.2.6.5 Ocean Color Research

Ocean color research centers on the study of visible and near infrared radiation and reflectance from the ocean. This research provides valuable information on biological and physical processes occurring in the ocean and on ocean circulation and sedimentation. The Wallops Airborne Oceanographic Lidar is an aircraft research instrument which studies ocean color by two methods. In the passive mode, a 32-channel spectrometer analyzes the light reflected from the ocean due to normal sunlight. In the active mode, a laser is fired downward from the aircraft and the resulting spectrum analyzed. These two modes together aid greatly in the determination of phytoplankton and chlorophyll concentrations and the identification of single-celled plants in the water. This information helps scientists understand the marine food chain.

### 2.2.7 Tracking Operations

#### 2.2.7.1 Support Eastern Range Launches

Wallops Flight Facility supports the Space Transportation System and Eastern Range Expendable Launch Vehicle launch operations with approximately 20 launches per year. On all high inclination Space Transportation System launches and some high inclination Expendable Launch Vehicle launches, Wallops Flight Facility provides radar and telemetry support. Wallops Flight Facility also provides radar tracking for selected orbital passes on all Space Transportation System missions.

#### 2.2.7.2 Orbital Tracking

In 1986, Wallops Orbital Tracking System was established at Wallops Flight Facility. This ground-based satellite tracking station acquires telemetry from satellites to support several important programs which include: the Cosmic Background Explorer (COBE), the IRS-P3 ( an Indian satellite), Meteosat, SEAWIFS, and STS. In FY 1994, a Transportable Orbital Tracking

Station (TOTS) began providing support to Fast Auroral Snapshot Explore. Telemetry data is delivered in real-time or near real-time. For high data rate S-band projects (> 10Mbps) digital cassette tapes are available at a greatly reduced cost when compared to the dedicated circuit costs. Post pass playback of high rate recorded data can be scheduled. The Wallops Orbital Tracking System currently provides approximately 25,000 hours of support per year.

#### 2.2.7.3 Atmospheric Sciences

The Atmospheric Sciences Research Facility at Wallops Island supports scientific investigations of the atmosphere. The Atmospheric Sciences Research Facility's unique capabilities for data acquisition, processing, display and recording have produced significant results in research conducted by governmental and non-governmental agencies. The instrumentation systems and technical support personnel have made important contributions to the understanding of atmospheric turbulence, cloud and precipitation development and dynamics, and lightening discharge characteristics and distribution patterns. This includes the effects of precipitation on the transmission of electromagnetic radiation. Permanent data acquisition systems at the Atmospheric Sciences Research Facility include two powerful radar systems, a data acquisition and recording system, and a Dobson spectrophotometer for ozone measurement. Personnel at the Atmospheric Sciences Research Facility provide support to systems operations, comprehensive testing, modification, repair, and fabrication services. Recent campaigns included travel to Australia, Brazil, the Bahamas, the South China Sea, and Switzerland.

Radiosonde data is made available twice daily into the National Weather Service upper air network, providing information that is used in atmospheric analyses and computer forecast models nationwide. Balloon flights also provide key information contributing to the safety of all rocket launches at Wallops Flight Facility. Meteorological Operations technicians also supply maintenance support to weather monitoring equipment on the facility.

The Weather Forecast Office provides several types of support to many customers at Wallops Flight Facility. The two-man Weather Office provides support in project meetings, daily television weather briefs, Wallops airfield observations, and twice-daily weather briefs to staff, aviators, and customers. Other duties include: weather warning and advisory support, hurricane, and severe weather round-the-clock support, climatological data processing and archiving, writing articles for Wallops Flight Facility weekly newsletter, as well as, participating in design and acquisition plans for a new weather data system.

### 2.2.8 Other Range Support

The unique resources at Wallops Flight Facility are used to support the programs of other agencies, nonprofit laboratories, and commercial space ventures. The use of the base facilities contributes to research that benefits the space program, aeronautics, transportation, agriculture, fisheries, and other industries, as well as, national defense. Elements of the Navy, Coast Guard, NOAA, and the Virginia Commercial Space Flight Association, partner with NASA to share the use of available facilities and services. Some commercial corporations currently use the spin and balance facilities, as well as, Wallops Flight Facility integration and launch facilities.

## 2.3 INSTRUMENTATION

Wallops Flight Facility range instrumentation systems include tracking and data acquisition in several areas, including radar, telemetry, optics and communications. These systems support the full range of sounding rockets, balloon, aeronautical research and development projects, and scientific experiments. Similar capabilities support mobile international operations.

### 2.3.1 Radar

Radar systems provide space position and/or target characteristic information for a variety of applications including surveillance, tracking, weather observation, and scientific remote sensing. The radar functions are performed by a variety of ground-based and airborne systems in support of the Wallops Test Range and Earth Science programs. The frequency bands in which these systems operate include UHF, L-, S-, C-, X-, Ku-, and Ka-band. Three surveillance radars and up to seven (3-fixed/4-mobile) tracking radars provide data for range safety and customer requirements for missions on the Wallops Test Range. These systems are located on the Main Base, the Mainland, and on Wallops Island. The targets that are tracked include aircraft, balloons, drones, expendable launch vehicles, satellites, and sounding rockets. Digital position data is recorded at the radar sites and transmitted to the Range Control Center in real-time in support of mission operations. Both NASA and contract personnel provide for the operations, maintenance, and sustaining engineering of the Wallops radar systems

### 2.3.2 Telemetry

Telemetry systems provide downlink data services from instruments and payloads flying on-board aircraft, balloons, drones, expendable launch vehicles, satellites, and sounding rockets. Science, engineering, and housekeeping data can be received, demodulated, and decoded by the telemetry ground stations using analog and digital data transmission techniques. The capabilities exist to record the data on-site, transmit it to the user in real-time, or to transmit it to the user when the mission or pass is complete. Telemetry downlink services are available in the following frequency bands: VHF, UHF, L-, S-, and X-band. Development work has begun on a new system at Ka-band. Uplink data services are also available in the S-band. The Wallops fixed telemetry systems are all located in and around Building N-162. The available systems include antennae with the following diameters: 2.4, 5, 7.3, 8, 9, and 11 meters. The telemetry facilities support both range operations and low earth orbiting satellites. The satellite tracking and data functions are a 24-hours per day, 365-days per year operation. Both NASA and contract personnel provides for the operations, maintenance, and sustaining engineering of the Wallops telemetry systems.

### 2.3.3 Optics

Wallops Optical, Photographic, and Video Facilities and Wallops Radar Instrumentation provide a range of services to visually record events for analysis and historical record. Remote controlled television cameras monitor range operations and provide safety-related information. Tracking cameras that include both film and long-range video recording systems provide visual information from remote locations for project and range support. The Photographic Laboratory

in Building E-2 on the Main Base provides developing and reproduction capabilities for photographic film. Cameras using video film or digital photography may record the following events:

- Rockets vehicle/payload build-up
- Launch pad operations
- Lift-off
- Visible portions of aircraft or rockets flight
- Airport runway activities
- Other project activities

High speed motion picture photography of ignition, lift off, umbilical releases, and rail exit are available upon request.

The following tables list fixed camera stations on Wallops Island and their capabilities:

**TABLE 2-3**
**WALLOPS ISLAND FIXED CAMERA STATIONS**

| Stations | Lens | Purpose | FPS | Film | Tape | TV Switcher |
|---|---|---|---|---|---|---|
| C1 | 40" & 80" | Launch/Flight | 128 | 16mm | VHS | TBD |
| C2 | 6" & 15" | Launch/Flight | 128 | 16mm | VHS | TBD |
| C4 | 40" & 80" | Launch/Flight | 128 | 16mm | VHS | TBD |
| C5 | 10", 20" & 8" | Launch/Flight | 128 | 16mm | VHS | TBD |
| C8 | 40" & 80" | Launch/Flight | 128 | 16mm | VHS | TBD |
| C9 | Camera tracking stations C9, C11 and C12 are mobile units with inter-changeable lens and frame speeds that are used for Wallops Runway projects and to provide photographic coverage to other locations around the world. | | | | | |
| C11 | | | | | | |
| C12 | | | | | | |
| C15 | 40" & 80" | Launch/Flight | 128 | 16mm | VHS | TBD |

**TABLE 2-4**
**WALLOPS ISLAND FIXED CAMERA STAND COVERAGE**

| Location | Purpose | Lens | FPS | Film |
|---|---|---|---|---|
| Pad 0 | Launch/Flight | Zoom | 400, 128 & 20 | 16mm & 70 mm |
| Pad 1 | Launch/Flight | Zoom | 400, 128 & 20 | 16mm & 70 mm |
| Pad 2 | Launch/Flight | Zoom | 400, 128 & 20 | 16mm & 70 mm |
| Pad 3 | Launch/Flight | Zoom | 400, 128 & 20 | 16mm & 70 mm |
| Pad 5 | Launch/Flight | Zoom | 400, 128 & 20 | 16mm & 70 mm |

Fixed cameras may operate unmanned during a launch.

### 2.3.4 Communications

Wallops Flight Facility operates ground-to-ground, air-to-ground, ship-to-shore, and inter-station communications systems. These systems are composed of radios, cables, microwave links, closed-circuit television systems, command and control communications, frequency shift tone keying systems, operational teletype systems, high-speed data circuits, and the Wallops Flight Facility NASCOM Network terminal. Wallops Flight Facility also makes use of satellite communications and fiber optics.

A cable plant extends buried copper and fiber optic cables to the Main Base, Mainland, and Wallops Island. There has been continued cable plant development with the installation of buried cables on all three Wallops Flight Facility areas. These systems provide the means for managing operations at Wallop Flight Facility and communication and coordination with related operations in other geographic areas, e.g., providing communications and tracking support for Space Shuttle operations at the Kennedy Space Center.

#### 2.3.4.1 Data Systems

Data are acquired during operations from radar, telemetry, optical, meteorological, timing, and communications systems. These data are processed by computers at Wallops Flight Facility to provide operations support and information for scientific experiments. A variety of data systems acquire, record, and display information in real time for command, control, and monitoring of flight performance.

#### 2.3.4.2 Command System

A command system allows flight termination and control of airborne vehicle's (sounding rockets, balloons, or aircraft) on-board experimental devices. In the case of rockets and balloons, the Range Safety Officer can terminate some flights in the unlikely event that a malfunction presents a range safety hazard. Communications systems development is performed by the Electrical Systems Branch (Code 565).

### 2.3.5 Meteorological Instrumentation

Wind data systems support launch operations. Fixed, balloon-borne, and optical sensors are available for coordinating experimental data with existing conditions. Current weather data from Wallops Flight Facility weather sensors on the Main Base and Wallops Island are continuously displayed on the local Wallops Flight Facility closed circuit TV system. An ionosphere sounding station can provide detailed data on ionosphere characteristics. A Dobson ozone spectrophotometer on the Mainland can provide total ozone measurements. Several lightning detection systems display lightning conditions locally and over the United States. An electric field measuring system is used with the lightning detection systems to quantify the probability of both local naturally occurring and triggered lightning.

### 2.3.6 Range Control Center

The Wallops Flight Facility Range Control Center in Buildings E-106 and E-107 controls launch, tracking, data acquisition operations, and aircraft using the Wallops Flight Facility Research Airport. It is the focal point for communications, operational management, and range safety. Instantaneous communications with all participants in a mission are used to coordinate complex operations.

### 2.3.7 Mobile Systems

Wallops Flight Facility supports balloon and sounding rockets campaigns in other areas of the world. Campaigns have been conducted in the Arctic and Antarctic regions, Australia, South America, and Europe. To provide radar, telemetry, and data support systems, similar to capabilities permanently available here at Wallops Flight Facility, mobile equipment has been designed and developed for transport. Personnel from Wallops Flight Facility accompany the equipment and often spend several months operating it in remote locations. The mobile facilities are tested and used at Wallops Flight Facility.

## 2.4 RESEARCH AND DEVELOPMENT FACILITIES

### 2.4.1 Research Runways

The Wallops Flight Facility Research Airport provides many services, including: communications, telemetry, enhanced radar tracking, flight path guidance, and other supporting roles for a variety of aeronautical research programs. Additionally, aircraft acoustic research programs, terminal area navigational research involving both transport and general aviation aircraft, conventional, segmented and curved path Microwave Landing System precision approach studies, and wing tip vortex studies are performed. Vehicles involved in this research range from transport to small general-aviation fixed-wing aircraft to helicopters, in addition to a variety of specially instrumented ground-test vehicles. Overall, these projects intermittently draw upon a broad spectrum of support resources from the Wallops Test Range.

One of the three airport runways has been specifically modified for aircraft traction studies. The runway surface has several sections made up of different materials and textures. Sections can be flooded with water with the depth controlled to within 1/10 inch. The runway is also equipped with a high-speed turnoff where techniques are studied that will provide guidance information to aircraft, permitting them to exit automatically from runways at high speed.

Most of the research projects originate at other NASA centers such as Langley Research Center at Hampton, Virginia; other government agencies, such as FAA; the military services; and a few private companies. Building N-159 provides hangar space for aircraft and laboratory space for research. Additional hangar space is available in Building D-1. Aeronautical research projects are controlled from the Aeronautical Projects Control Room on the fourth floor of the Wallops Flight Facility Range Control Center. Air traffic is controlled from Building A-1.

### 2.4.2 Sounding Rockets Support Labs

Engineering support for the NASA Sounding Rockets Program includes analytical, feasibility, and design studies; payload, vehicle, and recovery system engineering; rocket and payload test and evaluation; and data analysis. Engineering and system design, development and acquisition for data and communications systems, radar and optical systems, telemetry systems, and vehicle systems are performed by an organization of engineers and technicians supported by laboratories, testing, calibration, and data processing facilities.

#### 2.4.2.1 Payload Fabrication and Integration Laboratory

The Payload Fabrication and Integration Laboratory is located in Building F-10 and includes facilities for mechanical and electrical construction of payloads. The Payload Integration Laboratory also provides quality assurance and quality control inspections for assembled payloads. The laboratory can support multiple payload processes simultaneously including telemetry ground stations and clean room facilities. Work areas are available to perform preparatory and post-integration inspections. The telemetry ground station is capable of supporting multiple links for all types of systems flown.

#### 2.4.2.2 Environmental Testing Laboratory

Environmental testing of complete payloads, sub-assemblies, and components is accomplished at Wallops Flight Facility. Environmental testing verifies flight readiness through exposure to the intended flight environment. Special facilities for environmental testing are available in the Environmental Testing Laboratory located in Building F-10. The laboratory is adjacent to the Payload Integration Laboratory for convenience in payload handling and logistics.

##### *2.4.2.2.1 Static Loads Facility*

This facility, located in Building F-10, is designed to produce static bending loads on rocket payloads mounted vertically. The facility will accommodate payloads up to 25 feet (7.62 meters) in length and 44 inches (111.76 centimeters) in diameter.

##### *2.4.2.2.2 Rotary Accelerator*

The rotary accelerator provides radial acceleration for testing and calibrating payload components, hardware, and instrumentation. A rotating arm with the component attached is enclosed within a thick steel cylindrical shroud. Maximum size of the test article is 24 cubic inches (393 cubic centimeters).

##### *2.4.2.2.3 Spin Test Facility*

The spin test facility is primarily used for testing ejection and separation events that occur during a rocket flight. With the test article mounted on the facility turntable (to simulate rocket flight spin-up) the doors, covers, or equipment are ejected on command and retrieved undamaged by a soft capture net.

#### *2.4.2.2.4 Electromagnetic Shakers*

Four electromagnetic shakers are available for simulation of the shock and vibration flight environment for entire payloads or components of payloads.

#### *2.4.2.2.5 Thermal Vacuum Chamber*

The vacuum chamber is available for testing items up to 12 feet (3.7 meters) by 7 feet (2.13 meters).

#### *2.4.2.2.6 Physical Properties Determination*

Equipment is available that allows the determination of weight, mass center, and moments-of-inertia of entire payloads.

#### *2.4.2.2.7 Static and Dynamic Balancing*

Several balancing machines are available for static and dynamic balancing of entire payloads or components and payload/rocket motor combinations.

#### *2.4.2.2.8 Magnetic Calibration Facility*

This facility is located near Building F-10. It is constructed with non-magnetic materials. The facility can create a magnetic field of known strength used for the calibration of instruments.

### 2.4.3 Machine Shop Facility

A fully equipped machine shop in Building F-10 is capable of fabricating sounding rockets payloads and launch vehicle components. There are facilities for the fabrication of electrical components such as circuit boards, cables, and custom interfaces used between experimental and standard sounding rockets components.

### 2.4.4 Dynamic Balance Facility

A Dynamic Balance Facility, Building V-50, contains equipment for vertical and horizontal spin testing and balancing of rocket motors.

### 2.4.5 Balloon Laboratory

The Balloon Laboratory in Building D-101 performs materials testing of polymeric films and balloon component fabrication and testing to support the NASA Balloon Program.

### 2.4.6 Wave Tank

Wind-wave-current interaction studies are centered around the Wave Tank in Building N-159. This unique facility is used to study the complex processes that occur at the boundary between Earth's atmosphere and oceans. The tank itself is 60 feet (18.28 meters) long, 3 feet (0.91 meters) wide and 4 feet (1.22 meters) deep, containing approximately 5,000 gallons (18,927 liters) of water. Environment stimulation machinery can produce winds from 0 to over 50 miles per hour (0 to 80.47 kilometers per hour) and reversible water current of up to 100 gallons per second (378.54 liters per second). In addition, hydraulic drives can produce a variety of wave

patterns from either end or both ends of the tank. This facility is one of very few in the world in which air-sea interactions can be studied under controlled conditions. The facility is highly instrumented by many sensors to precisely measure conditions during experiments. Two mini-computers and a PC-type computer provide control, measurement and data analysis for the facility. Basic research and development are performed by universities, NASA, and, other government agencies. Typical research programs include short-wave modification by long-waves and wave interaction on current.

### 2.4.7 Rain Laboratories

The Rain Laboratory, located in Building N-159, researches the interaction between rain and the ocean. Its drop tower simulates rainfall and can vary drop size. Research projects have included rain effects on microwave scattering from the sea surface, mixing of fresh and saltwater, and gas exchange rates.

The Rain Simulation Facility located behind Building F-160, is used to calibrate various rain gauges and other measuring devices. This facility can vary the intensity of the rain event from a mist to a downpour. Various long-term rain-measuring devices are located outside the Rain Simulation Facility.

### 2.4.8 Wallops Island Launch Vehicle and Payload Preparation Facilities

Facilities for the preparation of launch vehicles and payloads are located on Wallops Island.

#### 2.4.8.1 Assembly Shops

Assembly buildings W-40, W-65, and Y-15 are used to support vehicle/payload integration and buildup. Building W-40 (Assembly Shop No.5) is equipped to support the U.S. Navy Vandal Program only. Building W-65 (Assembly Shop No.3) has five bays and a clean room. Bays 1 and 2 are fitted with a 7.5 ton (6.8 tonnes) overhead crane. Building Y-15 (Assembly Shop No.1) has eight bays with a 3 ton (2.72 tonnes) bridge crane in Bay 8.

#### 2.4.8.2 Launch Support Shop and Storage Area

These small shops provide support for the launch operations and storage for miscellaneous non-hazardous materials.

#### 2.4.8.3 Payload Checkout and Assembly Area

Buildings X-15 and M-16 provide space for payload assembly and checkout. Payload assembly and checkout space can also be provided in one or the other vehicle assembly building.

## 2.5 INFRASTRUCTURE

The major goals of the construction program currently underway are to restore an aging infrastructure, address environmental concerns, and enhance the Wallops Flight Facility's Research and Development capability.

The seawall is currently being updated as a major safety awareness project. Over the next 3 years, 5 million dollars will be spent to increase the height of the sea wall to 15 feet (4.57 meters) above mean sea level, for the entire length of the island. A land use plan has also been developed for Wallops Island which allocated particular areas for specific uses and takes into consideration NASA, user, and partner requirements as well as future needs.

The following recently completed projects have further enhanced Wallops Flight Facility infrastructure:

- Main Base underground electrical distribution completed with new switching station
- Water System repaired through Phase III
- New Water Towers on the Main Base and Wallops Island
- New Sewage Treatment Plant
- Storm Drain repair to include cleaning and lining pipe
- Sewage force main from Wallops Island to the Main Base
- Commercial launch pad constructed for the Virginia Commercial Space Flight Authority

The following projects planned for the near future will further enhance the Wallops Flight Facility Research and Development capability:

- Modify Radar Facilities at Buildings U-25 and U-30
- Revitalize Communication Ductbank System
- Repair Storm Drains
- Revitalize Water System, Phase IV
- Rehabilitate Buildings C-15, F-8, F-4, F-5, F-160, F-16, V-45, V-50, V-55, N-117
- Repair Chilled Water System
- Repair High Voltage Electrical Systems at various buildings
- Enlarge Rocket Storage Facility
- Construct Balloon Materials and Electronics Lab
- Construct Multi Payload Processing Facility
- Modify Fire Protection and Detection Systems
- Repair taxiway near Building N-159
- Install Power Monitoring System

The majority of the responsibilities for infrastructure operation, maintenance, and development are with the Facilities Management Branch (Code 228).

### 2.5.1 Utilities

Major upgrading is underway for significant portions of the approximately 40-year old electrical, water, and sewage systems.

#### 2.5.1.1 Electricity

Conectiv Power Delivery provides electrical power on separate lines to the Main Base, Mainland, and Wallops Island. The primary voltage at the Main Base is 12,470. The secondary voltages at most facilities are 208/120 and 480/277 three-phase. Portions of the grid system are "looped fed" from multiple direction and critical facilities have back-up emergency generators. During low-voltage periods, Wallops Flight Facility supplements electricity with generators as part of a peak load reduction program. The Facilities Management Branch has overall responsibility for the 25 portable and 5 stationary NASA generators. Short-term power sources are connected for temporary projects. NOAA has an auxiliary power source in the event of an outage and also participates in the peak load reduction program. Refer to Section 4.1.2, Energy Usage, for additional information regarding electricity.

#### 2.5.1.2 Water

All potable water on Wallops Flight Facility is obtained from 150 to 265-foot (61 to 80 meters) deep wells. Water withdrawal, usage, and quality are regulated by the Virginia Department of Environmental Quality and Virginia Department of Health. The water is used for domestic purposes and in facility activities, laboratories, projects, and fire protection. Water storage and distribution have been sized for fire protection. Five active NASA water supply wells provide potable water, after chlorination, to the Main Base. One additional active water supply well provides potable water to Wallops Visitor Center. NOAA receives potable water from an additional deep well.

Two ground water wells on the Mainland supply both the Mainland and Wallops Island with chlorinated potable water. Two shallow wells on the Mainland are used for fire protection. However, one well is not functioning and will be closed in the future.

The Town of Chincoteague, Virginia, operates five deep wells and three shallow wells on Wallops Flight Facility property by easement. The Town of Chincoteague system supplies the Department of the Interior and services an estimated 2,840 residential, and 400 commercial and institutional connections.

Refer to Section 4.1.3.2, Groundwater, for additional information regarding wells, including well depths for the active supply wells.

#### 2.5.1.3 Sewer and Sanitary Facilities

Virginia Department of Health and Virginia Department of Environmental Quality regulate sewage treatment and other discharges. Wallops Flight Facility has a Federally Owned Treatment Works and septic systems. Three permitted outfalls are included in monthly

Discharge Monitoring Reports. The Main Base primarily uses the Federally Owned Treatment works but has some septic systems. The Mainland has only septic systems. Wallops Island is linked to the Federally Owned Treatment Works via a force main. Refer to Section 4.1.3.1.2, Wastewater, for additional information regarding sewer and sanitary facilities.

#### 2.5.1.4 Solid Waste Management

A private contractor collects solid waste and disposes of it at Accomack County Landfill-Oak Hall facility. The Environmental office picks up hazardous waste from generator locations and stores it on-site for less than 90 days. A licensed hazardous waste transporter then transports the hazardous waste off-site to a licensed Treatment, Storage, and Disposal facility. Various forms of solid waste are recycled at the facility. These include cardboard, office paper, oil, anti-freeze, solvent, paint thinner, scrap-metal, toner cartridges, lead-acid batteries, and kitchen grease. Refer to Section 4.1.8, Solid Waste, for additional information regarding solid waste management.

#### 2.5.1.5 Heating Systems

Steam for building heating is provided by two 700-HP and one 500-HP boiler at the central boiler plant, D-8. Steam flows through pipes to the D buildings, E buildings, F buildings, Building C-15, and Building N-159. All other buildings are heated using individual hot-water boilers, heat pumps, or electric heaters.

#### 2.5.1.6 Storm Drainage and Air Emissions

Storm drainage and air discharges are regulated by the Virginia Department of Health and Virginia Department of Environmental Quality. Work impacting wetlands is also coordinated through the appropriate regulatory agencies.

### 2.5.2 Housing

#### 2.5.2.1 Coast Guard Housing

Families of the Coast Guard Eastern Shore Group occupy 25 houses adjacent to the Main Base.

#### 2.5.2.2 Navy Housing Center

The Navy Housing Center includes residences for both bachelors and families. The Bachelor Officers Quarters contains 6 efficiency units and 10 one-bedroom units. The Bachelor Enlisted Quarters, with its attached dining facility, provides dormitory living for up to 120 personnel. There are four two-bedroom and 24 three-bedroom homes. New Navy housing will include 10 duplex units for 20 families.

#### 2.5.2.3 Buildings F-4 and F-5 Dormitories

Buildings F-4 and F-5 are dormitories for visiting experimenters, attendees of the Management Education Center Programs, and other individuals conducting business at Wallops Flight Facility.

### 2.5.3 Transportation

#### 2.5.3.1 Land Transportation

The Main Base and Mainland are connected by approximately 6 miles (9.65 kilometers) of paved, two lane, Commonwealth of Virginia road 679. A NASA-owned road, bridge, and causeway link Wallops Mainland to Wallops Island. Hard surface roads provide access to all buildings on Wallops Flight Facility. NASA maintains all roads within the facility. Additionally, the Main Base has extensive sidewalks. Limited snow removal capability exists to maintain essential operations.

NASA and most organizations at Wallops Flight Facility have a variety of vehicles ranging from sedans, vans, and trucks to bicycles. Most NASA-owned vehicles are maintained by Wallops Logistics Branch (Code 233), which provides maintenance including washing, lubricating, oil changing, and repairs. Vehicles owned by partner organizations or contractors are generally maintained by those organizations unless other arrangements have been made with NASA. Several organizations provide bicycles for employees to use on the Main Base.

There are established facilities and procedures for the movement of hazardous materials, such as rocket motors at Wallops Flight Facility.

#### 2.5.3.2 Air Transportation

##### *2.5.3.2.1 Wallops Flight Facility Research Airport*

The Wallops Flight Facility Research Airport, owned and operated by NASA, was originally the Chincoteague Naval Air Station constructed during World War II. It is equipped to provide normal aircraft services. An aircraft control tower is located at the intersection of the Wallops runways on the Main Base. It operates during normal working hours. Arrangements can be made for use at other times.

##### *2.5.3.2.2 Aircraft Fleet*

Wallops Flight Facility operates a fleet of two program support (P-3 and C-130) and one mission management aircraft, the Beechcraft King Air. The program aircraft are used as research platforms for scientific payloads. Table 2-5 lists the aircraft currently assigned at Wallops Flight Facility. The Wallops Flight Facility aircraft fleet is operated, maintained, and managed by highly qualified flight crews and personnel with the goal of providing efficient and safe airborne operations. Aircraft are modified and upgraded, as needed, for mission requirements. The maintenance and operation of the aircraft are the responsibilities of the Aircraft Office (Code 830).

**TABLE 2-5**
**WALLOPS FLIGHT FACILITY AIRCRAFT**

| Tail Number | Type | Manufacture, Date of Manufacture | Engines Number/Type |
|---|---|---|---|
| N8NA | King Air 200 | Beechcraft Corporation, 1981 | 2/PT6A-42 |
| N426NA | P-3B Lockheed | Lockheed Aircraft Corp., 1966 | 4/T-56-A-16 |
| N427NA | C-130 | Lockheed Aircraft Corp., 1981 | 4/T-56-A-16 |

#### 2.5.3.3 Marine Transportation

NASA operates one small powered Langley boat. Partner organizations may use ships of various types and sizes to conduct research off the coast of Wallops Island. NASA works in cooperation with partners and other customers whose research involves boats for the recovery of flight hardware or scientific measurements. These boats generally operate out of the Chincoteague USCG Station, Patuxent River Naval Air Station, Patuxent, Maryland, or Ocean City, Maryland. The Marine Science Consortium docks and operates six boats out of the Boat Basin near the Wallops Visitor Center.

## 2.6 SPECIAL SERVICES

### 2.6.1 Range Safety

Range safety is of paramount consideration in all successful range operations. Safety requirements draw on the unique and exhaustive experience of Wallops Flight Facility with over 50 years experience in range operations, design, and technology. Safety is considered in all phases of mission planning, design, and engineering through the successful conclusion of a mission.

The range safety policies and procedures at Wallops Flight Facility apply to all mission activities conducted and managed by Wallops Flight Facility and to all NASA employees, contractor personnel, Principal Investigators and their support personnel.

The Range Safety Office monitors launch area operations, determines wind profiles and launcher settings, keeps track of ships and aircraft in the operating area, and follows the course of rocket flights for all rocket launches. The Safety Office (Code 803) plays a vital role in planning and conducting range safety activities.

### 2.6.2 Fire Prevention and Protection

The Wallops Flight Facility fire prevention and protection program implements federal standards in the design, construction, and maintenance of all facilities and grounds. At the inception of all projects and through their design life, new construction and facility modifications undergo a

thorough plan review by the Safety Office (Code 803) and the Environmental Office (Code 205.2). Control of construction fire hazards is realized by utilizing mandatory accident prevention plans and monitoring programs. Once facilities are erected, the Wallops Flight Facility fire prevention program, managed by the Safety Office (Code 803) substantially reduces the risk of a fire incident.

#### 2.6.2.1 Main Base

The fire prevention and protection program relies heavily on the support of the Wallops Flight Facility Fire Department. Fire Department personnel conduct frequent (weekly to monthly, depending on facility hazards) facility fire prevention inspections. On an annual basis, the evacuation plans of all occupied buildings are evaluated by performing fire drills. Annual test and inspections of all building fire protection systems are conducted according to National Fire Protection Association standards.

There are ten fire fighting vehicles available ranging from a 7,000 gallon (26,498 liter) tanker with 1,200 gallon (4,542 liter) Aqueous Film Forming Foam capacity to a 300 gallon (1,135 liter) crash and rescue vehicle. A fully equipped hazardous materials spill response trailer is able to react to hazardous materials incidents.

In addition to the fire suppression capabilities of the Fire Department, the majority of Wallops Flight Facility buildings have automatic sprinkler systems. In the future, all new buildings and many existing buildings lacking fire suppression systems will be provided with an automatic means of fire control. Portable fire extinguishers are stationed throughout Wallops Flight Facility.

The Main Base has a Central Fire Alarm System. The system has manual pull stations located both outside and inside buildings. Various automatic fire detectors complement the pull stations. The existing system is currently being extensively upgraded and multiplexers will be strategically located to channel critical fire information to the central station. This capability will allow the Fire Department to shorten its response time to an incident (response time being the most critical factor for fire exposure control and suppression).

#### 2.6.2.2 Wallops Island and Mainland

Fire prevention services are provided for Wallops Island and the Mainland by Fire Station 2. Adequate water reserves are maintained in aboveground storage tanks and ample portable fire extinguishers are provided.

The following fire fighting vehicles are maintained at Station 2:

- 2 engines: 500 gallon (1,893 liter) tank with 750 gpm (2,839 liters per minute [lpm]) pump and a 300 gallon (1,135 liter) tank with 750 gpm (2,839 lpm) pump
- 1 crash unit: 500 gpm (1,893 lpm) pump with 300 gallon (1,135 liter) tank and 60 gallon (227 liter) foam
- 1 ambulance
- 1 support pick-up truck

### 2.6.3 Security

The Security Office (Code 205.1) provides both institutional and program security. Twenty-four hour guard service is provided at four fixed posts throughout the facility. Access to Wallops Flight Facility Main Base is controlled by a guard post at the Main Gate entrance. A second guard post is located at the common entrance to the Mainland and Wallops Island. Visitors obtain passes from security personnel at the Main Gate Security Building. Electronic security systems are located at restricted areas on Wallops Flight Facility to limit access to authorized personnel only. Increased security measures can be implemented when required by projects and programs and in response to heightened threats.

### 2.6.4 Calibration Laboratory

A Calibration Laboratory in Building F-160 is equipped to perform repair and calibration of test instruments. The laboratory supports NASA and partners such as the Navy. The Calibration Laboratory maintains a standards laboratory for required standards. The equipment in the standards laboratory is traceable to the National Institute of Standards and Testing.

### 2.6.5 Chemical Laboratory

The Chemical Laboratory in Building F-160 performs a variety of testing functions. It is the primary source for chemistry tests for the Federally Owned Treatment Works, including biological oxygen demand and chemical oxygen demand. Laboratory personnel also perform chlorine tests, record temperatures, and complete other waste treatment tests, as required. The Chemical Laboratory personnel monitor the water supply through well readings, pump flow readings, metals in water, and perform other drinking water quality tests. The Chemical Laboratory performs analysis as requested by the U.S. Government. Examples include wear metal in aircraft engine oils, particulate counts, moisture and viscosity tests, and polychlorinated biphenyl screen analysis. The Chemical Laboratory also performs preparation and calibration of balloon package ozone sondes.

### 2.6.6 Safety and Health

The Environmental and Security Office (Code 205) and the Safety Office (Code 803) cooperatively provide institutional safety services. These safety services control physical conditions and operating practices with the objective of eliminating factors known or anticipated before personal illness/injury and/or property damage occur. Wallops Flight Facility safety services include: managing the fire protection program; promoting the industrial health and safety program; monitoring the radiological safety program; implementing overall NASA safety policies, regulations, and standards applicable to in-house and contractor activities; as well as providing for administrative supervision of the Occupational Medical Health and the Industrial Health Programs. A dispensary is located in Building F-160.

### 2.6.7 Personnel

The Human Resources Operations Office (Code 113) provides the complete range of personnel support services to Wallops Flight Facility for NASA civil service employees. Responsibilities include organizational analysis and position management, classification, wage administration (including leave and hours of duty), employee benefits, staffing and internal placement, performance management, and support to the Equal Employment Opportunity Program. The office provides management advisory services in employee and labor relations in consultation with the Labor and Employee Relations Office.

### 2.6.8 Physical Plant

#### 2.6.8.1 Maintenance and Repair

The diverse functions and the magnitude of Wallops Flight Facility projects require continuing routine repairs and maintenance of buildings, grounds, and facilities. Aircraft, vehicles, laboratory equipment, and instrumentation must be continually maintained. Existing infrastructure such as roads and utilities must be maintained on a regular basis to ensure the ongoing operation of the facility. Existing buildings require ongoing maintenance, repairs, modifications, and upgrades that are managed by the Wallops Facilities Management Branch (Code 228). Buildings may be rehabilitated or upgraded to meet specific project needs.

#### 2.6.8.2 Shoreline Protection

Wallops Island is a barrier island that changes with normal long-shore currents and powerful storm tides. To minimize the effects of erosion and support range operations, a seawall was constructed on Wallops Island in the 1950's. It is currently under repair. The rehabilitated seawall is designed for the 20-year storm and is being constructed under permits from the Accomack County Wetlands Board, The Virginia Marine Resources Commission and the U. S. Army Corps of Engineers. No shoreline protection is required for the Main Base or Mainland due to the lack of exposure to open water.

#### 2.6.8.3 Dredge and Fill Operations

In the past, the U. S. Army Corps of Engineers has dredged Chincoteague Channel and Hog Creek. The sediment dredged from Hog Creek was placed on the southern end of Wallops Island. Chincoteague Channel has slowly been collecting sediment. Assawoman Inlet on the southern end of WI closed entirely in 1987. Both the northern (Chincoteague Channel) and southern channel (Assawoman Inlet) will change in the future by naturally occurring phenomena (e.g., currents, storms, tide surges) or by human intervention.

### 2.6.9 Management Education Center

The Management Education Center was established in 1977 as an Agencywide training facility to support human development programs. The majority of programs are held in Building E-104. Buildings F-4 and F-5 provide dormitory accommodations for visiting participants.

### 2.6.10 Wallops Visitor Center

The Wallops Visitor Center is located on Route 175 east of the Wallops Flight Facility runways. It maintains a collection of spacecraft and flight articles, including exhibits about the history of manned flight, Wallops Flight Facility research activities, and other NASA research projects. Special movies and video presentations also can be viewed in the Krieger Educational Center, an integral part of the Wallops Visitor Center. There is a gift shop with space souvenirs, and refreshments may be purchased from vending machines. Guided tours of Wallops Flight Facility are available to organized groups including school, civic organizations, and tour groups. Each tour is designed to meet the educational level and interest of the group members. Special programs, which range from lectures and exhibits on NASA programs to monthly model rocket demonstrations, are held throughout the year.

### 2.6.11 NOAA/NESDIS CDA Station

The NOAA National Environmental Satellite and Data Information System (NESDIS) Command and Data Acquisition (CDA) Station lies on the northeast quadrant of the Wallops Flight Facility Main Base. Access to the NOAA facility is through a separate gate. This station provides a 24-hour per day flow of weather satellite derived sensor data to the Nation and the world. To support this operation, nine antenna systems, ranging in size from 24 to 85 feet (7.5 to 28 meters) in diameter, and associated equipment, to track, monitor and command these weather satellites are used 24 hours per day. The facility is divided into two separate ground stations: Polar and Geostationary. The Polar Orbiting Environmental Satellites provide operational coverage of the entire Earth four times per day. The Geostationary Satellites observe the Eastern and Western United States and adjacent ocean areas from their vantage points 22,300 miles (35,888 kilometers) over the Equator, and coverage zones which extend well into the Southern Hemisphere.

Currently, data from the European weather satellite, Meteosat-3, is being received. Meteosat-3 was relocated to provide weather images to both the East and West Coasts of the United States and Central and South America.

### 2.6.12 Land Use and Operational Considerations

The *Goddard Space Flight Center Facilities Master Plan, Volume 3*, dated June 1988, contains detailed information on land use planning and restrictions including utility capabilities, hazard areas, buffer zones, and airfield approach zones. These must be considered in planning and conducting operations and/or locating temporary and permanent structures at Wallops Flight Facility. Wallops Island is an extremely valuable and unique resource. There are a number of factors and guidelines that are considered in determining appropriate operations or locations for facilities:

- Wallops Island is a barrier island with a fragile ecology that contains endangered species and large areas of wetlands. The cumulative impact of operations/facilities and mitigation projects are considered in evaluating proposed additional activities.

- Only proposed activities that can be clearly justified, on the basis of technical considerations for performance, are conducted on Wallops Island.

- Personnel assigned to conduct activities are kept to the minimum necessary to meet functional requirements.

- Wallops Flight Facility operates and maintains a core of launch and launch support facilities on Wallops Island between launch areas 0 through 5. Generally, only launch and launch related activities are conducted in this area.

In addition to the above, the following guidelines apply to all areas of Wallops Flight Facility:

- The placement of facilities/activities is governed primarily by functional rather than organizational considerations.

- Wallops Flight Facility is to remain an "open" facility, i.e., access restrictions will be limited to those essential for security and safety. Access control is maintained by Wallops Flight Facility. More restrictive access controls required by a project or partner shall be accomplished in a manner that provides unrestricted access to all other NASA facilities.

- Activities sponsored or funded by groups other than NASA are conducted in a manner and on a schedule that will not compromise the accomplishment of NASA programs.

- Wallops Flight Facility operates a single test range for all activities conducted at/from Wallops Flight Facility.

- Whenever possible, joint use of systems and facilities is considered to avoid duplicate capabilities and additional costs.

- Augmentations of Wallops Flight Facility systems, facilities, and capabilities required to support a partner, project, or user are to be funded by the requiring organization or, when appropriate, jointly funded.

- There are radio frequency quiet zones on the NASA facility under specific usage restrictions. The *Goddard Space Flight Center Facilities Master Plan, Volume 3*, dated June 1988, shows these zones graphically.

# 3.0 PURPOSE AND NEED FOR ONGOING OPERATIONS

## 3.1 PRIMARY MISSIONS

The *Wallops Mission 2000*, dated July 21, 1997 delineates the following mission statement, "The mission of Wallops is to further scientific, educational, and economic advancement by providing the facilities and expertise to enable frequent flight opportunities for a diverse customer base."

In pursuit of this mission NASA will:

- Manage and implement NASA's Sounding Rocket and Balloon Programs in support of Earth science, space science, and technology. New Technologies such as a 100-day balloon capability may be integrated into the programs.
- Manage and provide technical support for University Class Explorer missions and small shuttle payloads.
- Be a high-fidelity proving ground for enabling the development of next generation low-cost orbital launch technologies such as the Bantam Lifter.
- Establish partnership arrangements with its Navy partners and other major users to develop and promote the use of Wallops as an operational test facility.
- Promote the development of a commercial orbital launch complex, supporting small- to medium-class launch requirements.
- Form partnerships with industry and academia to foster educational outreach opportunities.

## 3.2 CRITICAL FACTORS

The *Wallops Mission 2000* outlines the goals critical to the success of this mission. These goals drive the approach used at Wallops Flight Facility in accomplishing the mission.

- Be established as an integral element in achieving NASA's strategic objectives for scientific and educational excellence through cost-efficient integration, launch, and operations of suborbital and small orbital payloads.
- Serve as a key facility for operational and certification of NASA and commercial next-generation, low-cost orbital launch technologies.
- Be recognized as a role model for pioneering productive and innovative government, industry, and academic partnerships.

## 3.3 NASA ACTIVITIES AND MISSIONS

Wallops Flight Facility's primary focus is on integration, launch, and operation of suborbital and small orbital payloads, and on serving as an operational test site for the next generation of low-cost launch technologies. Wallops mission elements include Suborbital Programs, Orbital Programs, Test Range, and Interagency and Commercial Support.

### 3.3.1 Trends

The following trends will affect operations at Wallops Flight Facility. These future activities are planned for and need to be accommodated in all facility operations.

#### 3.3.1.1 Sounding Rockets Program

- Reduce NASA infrastructure cost by encouraging the contractor to use government furnished equipment for external reimbursable work
- Develop, within NASA, a larger sounding rockets customer base.
- Investigate partnerships with Department of Defense to provide complete sounding rockets support.
- Modernize systems to lower cost and increase capabilities.
- Increase the utilization of the Wallops Test Range to lower cost.
- Enhance student launch opportunities and encourage the use of sounding rockets in educational outreach initiatives.
- Cooperate with the Virginia Commercial Space Flight Authority to develop sounding rockets related educational projects.

#### 3.3.1.2 Balloon Programs

- Expand the capabilities of the balloon program, improve mission control and operations, and integration of science instruments through development of an Advance Long Duration Ballooning capability.
- Form partnerships with the Joint Weapons Warfare Center and the United States Air Force in balloon technologies.
- Partner with other NASA Centers for exploration of Mars, Venus, Jupiter, and Saturn.

#### 3.3.1.3 Aircraft Fleet

- Combine aircraft services under the general new performance-based contract.
- Excess underutilized aircraft.

#### 3.3.1.4 Remotely Piloted Vehicle Program

- Support the development needs for Remotely Piloted Vehicles/Unmanned Aerial Vehicles by serving as a central resource between investigator's requirements and industry providers.
- Encourage the use of airfield, airspace, and test range facilities.

#### 3.3.1.5 Orbital Tracking

- Transfer the operations, maintenance, and sustaining engineering efforts for the orbital tracking systems to the Consolidated Space Operations Contract.
- Monitor the performance of the contractors.

- Provide test-bed systems and services by which new technologies can be tested and verified before inclusion into existing ground stations.

#### 3.3.1.6 Wallops Test Range

- Cooperate with the Virginia Commercial Space Flight Authority to market Wallops capabilities and services and to promote the use of Wallops as an operational test facility.
- Increase the number of NASA sounding rockets and Department of Defense launches.
- Enhance cost efficiency by initiating a performance-based contract for the test range.

#### 3.3.1.7 Observational Science

- Plan and conduct laboratory and field measurements to improve the fundamental knowledge of remote sensing, to evaluate sensor systems, and to quantify their performance.
- Manage advanced planning, design, and flight performance analysis of Earth sensing spacecraft instruments.
- Develop, maintain and operate research facilities (i.e. wave tanks; aircraft in-situ and remote sensors; ground, balloon, and rocket based ozone detectors; and balloon and rocket borne meteorological instrumentation).
- Maintain engineering laboratories in order to design and develop new sensor systems and data acquisition systems.
- Develop geophysical parameter algorithms for its own instrument observations as well as furnish this information for flight projects.
- Perform field experiment planning and management, platform and system interfacing, and data acquisition for itself, other NASA, and scientific community investigators.

#### 3.3.1.8 Environmental

- Respond to increased concern throughout the facility over the impact of activities on the environment.
- Meet environmental requirements through coordination with various regulatory agencies.

#### 3.3.1.9 Institutional

- Oversee environmental programs and provide occupational health and security services.
- Perform program, institutional procurements, and industry assistance for NASA and its tenants.
- Plan, design, construct, and maintain facility and utility systems.
- Manage logistical operations including transportation, supplies, and equipment.
- Provide information management, library, and reproduction services.

#### 3.3.1.10 ISO 9001

The scope of the GSFC Quality Management System applies to the hardware, software, material, and services delivered to customers as the result of the following core processes at Wallops Flight Facility:

- Science Enabling - including the grants process, provision of data to the scientific community, science support tools, proposal support process, and science research management process.
- Systems Development – including orbital flight systems; sounding rocket, aircraft, and balloon carrier systems; and ground based mission operating and data acquisition systems.
- Program/Project Management – including cost, schedule, and technical control; review and reporting; budgets; procurement; contracts; and safety and mission assurance.
- Technology Enabling Process – including the technology research and development management process, mission-specific products, transfer, and commercialization.
- Mission Operation Process – including operations of on-orbit spacecraft, maintenance of on-orbit operations systems, collection and preservation of all data from on-orbit spacecraft, and communications support to other NASA missions operations.

### 3.3.2 NASA Activities

In addition to activities associated with the NASA Sounding Rockets and Balloon Programs, Wallops Flight Facility will conduct scientific studies in earth and space sciences, and aeronautical research. The Wallops Orbital Tracking Station (WOTS) provides tracking, telemetry, and data acquisition support for various NASA research satellites, and supports the Space Shuttle Program. These facility based scientific studies include very important programs pertaining to atmospheric dynamics, atmospheric optics, ocean physics, microwave altimetry, ocean-color research, and wind-wave-current interactions.

The airfield is used by NASA to conduct real-time aeronautical tests in support of aeronautical research activities. Aircraft are used as aerial platforms to support the development of remote sensing techniques and instruments to measure ocean and atmospheric parameters and to conduct scientific missions. Wallops Flight Facility provides communications, telemetry, radar tracking, and flight path guidance, as well as refueling and maintenance facilities for aircraft of all types. The airfield is also used as a divert field for aircraft (commercial, private, and military) which are experiencing difficulties in flight.

The Management Education Center will continue to be housed on the Main Base. The Management Education Center is used to conduct the NASA Management Education Program, the Goddard Leadership Education Series and the Langley Research Center's Management and Supervisory Training Program.

NASA activities are expected to continue to expand in the twenty-first century. NASA has adopted the mixed fleet concept that increases the use of Expendable Launch Vehicles to place

small satellites into Earth orbit. The expanding use of Expendable Launch Vehicles will continue to increase launch and launch support activities at Wallops Flight Facility. This is evident in the commercial space activities supported by Wallops Flight Facility, particularly the Pegasus programs. The Pegasus Program began launches in FY 1994. Additionally, facility support of the National Aerospace Plane Project has increased launch rates due to the use of sounding rocket aerodynamic model and prototype testing. Discussions of current and future Wallops Flight Facility operations are available in two documents revised monthly. The two documents are:

- Wallops Flight Facility Memorandum, distributed monthly, from 840/Chief, Range and Mission Management Office, Subject: Goddard Space Flight Center/Wallops Flight Facility Schedule of Flight Test Operations, Dated (Current month), and Summary of Flight Test Operations Performed During (previous month), revised monthly.
- The Progressive Summary for the previous month and the Milestone Schedules for the upcoming month, prepared monthly, and distributed by Code 840.

## 3.4 PARTNER ACTIVITIES

The U.S. Navy, USCG, and NOAA use Wallops Flight Facility through partner agreements. In some instances, partner organizations build facilities for operations, with the understanding that Wallops Flight Facility will retain the buildings after the partner agreement expires.

The U.S. Navy Surface Combat Systems Center is the largest partner. Wallops Island is home to the unique replica of an AEGIS cruiser and its destroyer combat systems. These systems are used to train naval officers and enlisted personnel on the operation and maintenance of sophisticated equipment used by the fleet on board their AEGIS cruisers and destroyers. The systems are also used to test concepts and solve operational problems. Other technical missions include Lifetime Support Engineering, In-Service Engineering, Systems Level operations, and maintenance training. The Surface Combat Systems Center supports the AEGIS Training Unit by providing equipment on which replacement crew training is held. The U.S. Navy, Ship Self Defense System Facility on Wallops Island also conducts research, development, testing, and evaluation elements of shipboard systems, integration, and demonstrations of new shipboard systems. Wallops Flight Facility also provides missile launch support for the Navy. The VANDAL target vehicle is used as a target by operational naval forces.

The NOAA/NESDIS CDA Station will remain at this facility for the foreseeable future. The National Environmental Satellite and Data Information System is a 24-hour per day operation that provides vital weather and satellite-derived sensor data to both national and international users.

The USCG uses a family housing area adjacent to Main Base. The USCG will continue to occupy approximately 25 housing units in this area.

The Virginia Commercial Space Flight Authority has office space on the Main Base and Launch Pad 0-B on Wallops Island.

# 4.0 AFFECTED ENVIRONMENT

The purpose of this section is to present information regarding environmental resources on and in the vicinity of Wallops Flight Facility (Figure 4-1) that may be affected by NASA operations. This section is intended to provide a baseline source of information for use in the preparation of a project-specific Environmental Assessment or Environmental Impact Statement. This section is divided into three main categories with other resource categories beneath. The environmental resource categories are typical of an Environmental Assessment or Environmental Impact Statement. They include: Physical Factors (Land Resources, Energy Usage, Water Resources, Wetlands, Floodplains, Air Quality, Radiation, Noise, Solid Waste, and Regulated Substances); Biological Factors (Biological Resources, Threatened and Endangered Species); and Social and Economic Factors (Socioeconomic Environment and Cultural Resources).

## 4.1 PHYSICAL FACTORS

### 4.1.1 Land Resources

#### 4.1.1.1 Introduction

Wallops Flight Facility is located in the northeastern portion of Accomack County, Virginia, on the Delmarva Peninsula. Wallops Flight Facility is comprised of the Main Base, Mainland, and Wallops Island. Refer to Section 1.4, Description of Wallops Flight Facility, for a description of Wallops Flight Facility.

Facilities on the Main Base include runways, hangars, offices, and housing on 1,800 acres (720 hectares) (Reference 66). The Mainland facilities include radar, antennae, and transmitter systems and associated buildings on 100 acres (40.5 hectares) (Reference 46). Wallops Island has testing facilities, launch facilities, storage buildings, and office buildings on 4,600 acres (1,680 hectares) (Reference 46). Activities and studies undertaken at Wallops Flight Facility include rocket launches, radar testing and tracking, and aircraft testing.

Wallops Flight Facility's proximity to the ocean relates directly to the function of the facility. The ocean provides a safety buffer zone. Ocean research is conducted by NASA GSFC's Earth Sciences Directorate. Partner organizations on Wallops Flight Facility use the ocean to simulate sea situations on land. Navy buildings are equipped with a ship's systems that can be used to train personnel and to test ship capabilities. Refer to Chapter 2.0, Description of Installation and Operations for a summary of ongoing activities at Wallops Flight Facility.

The following description of Wallops Flight Facility site topography, drainage, soils, and geology provides baseline information for development proposals. The existing land usage and proposed land usage are also reviewed.

#### 4.1.1.2 Topography and Drainage

The topography of Wallops Flight Facility is typical of the Mid-Atlantic coastal region, and is mostly flat without unusual features. Numerous inlets, marshes, bays, creeks, and tidal estuaries

are situated between Wallops Island and the Main Base. Flooding occurs through these inlets and across the marshes to the low-lying areas when the water level of the Atlantic Ocean rises during storms.

The Main Base, Mainland, and Wallops Island are relatively flat with no extreme deviations in the topography. The maximum elevation on the Main Base is approximately 40 feet (12.2 meters) above mean sea level. The runway area resembles a plateau in that it is extremely flat and at a higher elevation than most of the Main Base. The plateau effect from the runway area diminishes as the topography approaches the waterways.

The Mainland consists of flat areas with gradual eastern slopes leading to the tidal marsh. Elevation on Mainland reaches approximately 20 feet (6.1 meters) above mean sea level. Presently, the highest elevation on Wallops Island is approximately 15 feet (4.6 meters) above mean sea level. However, topography on barrier islands changes due to dynamics of ocean currents, wind erosion, and severe weather conditions.

The Main Base has both natural drainage patterns and stormwater drains to intercept and divert flow. The natural drainage pattern on the northern portion of the Main Base drains to the Mosquito Creek and eventually flows to the Atlantic Ocean. The eastern and southeastern portions of the Main Base have a natural drainage pattern that flows to the Simoneaston Bay, then into Cockle Creek, Shelly Bay, and Chincoteague Bay, before draining to the Atlantic Ocean. The natural drainage pattern on the western and southwestern portions of the Main Base is toward Wattsville Brook, and then to Mosquito Creek and on to the Atlantic Ocean. Stormwater drains on the Main Base intercept natural drainage ditches and divert the flow to numerous discharge locations. Stormwater drains are located throughout the developed portion of the Main Base and the majority of stormwaters discharge into the surrounding waterways, and eventually the Atlantic Ocean.

On the Mainland, the eastern sloping grade forms a natural drainage pattern that flows to Hog Creek, and then to Oyster Bay, Assawoman Creek, and finally the Atlantic Ocean. Surface water on Wallops Island flows west through numerous tidal tributaries and subsequently flows to the Atlantic Ocean. A section of the intracoastal waterway is located west of Wallops Island and east of the Main Base and Mainland. Additionally, Wallops Island has storm drains that divert the flow to several individual discharge locations. For further information regarding the surface water drainage patterns refer to Section 4.1.3.1, Water Quality.

### 4.1.1.3 Geology and Soils

Located within the Atlantic Coastal Plain physiographic province, Wallops Flight Facility is underlain by approximately 7000 feet (2,133.5 meters) of sediment. This sediment lies atop crystalline basement rock. The sedimentary section, ranging in age from Cretaceous to Quaternary, consists of a thick sequence of terrestrial, continental deposits overlain by a much thinner sequence of marine sediments. These sediments are generally unconsolidated and consist of clay, silt, sand, and gravel. The regional dip of the units is to the east, toward the shore (Reference 66). The soil classifications for Wallops Flight Facility (Table 4-1) are based on the Accomack County Soil Conservation Service preliminary soil classification map (Reference 4).


**Figure 4-1**

**Vicinity of WFF, Including Chincoteague Island, Virginia**

The coastal plain soils of the Eastern Shore are generally very level soils that are considered to be prime farmland by the United States Department of Agriculture. The dominant agricultural soils are high in sand content which results in a highly leached condition, an acid pH, and a low natural fertility (Soil Conservation Service Document, 1988). Adequate artificial drainage improves productivity for poorly drained soils. Prime and unique farmlands in Accomack County are classified by the Soil Conservation Service as the following soils:

- Bojac fine sandy loam soils
- Bojac loamy sand soils
- Munden fine sandy soil
- Munden loamy sand
- Dragston fine sandy loam, if adequately drained
- Nimmo fine sandy loam, well-drained

**TABLE 4-1**
**PREDOMINANT SOIL TYPES AT WALLOPS FLIGHT FACILITY**

| LOCATION | SOIL TYPE | TYPICAL SLOPES | DESCRIPTION |
|---|---|---|---|
| MB – inland Areas | Bojac fine sandy loam | 0-2% | Nearly level, very deep, well drained soils. Can be used as prime farmland. |
| MB – perimeter areas | Molena loamy sand | 6-35% | Very deep and somewhat excessively drained. The severe erosion potential and low availability of water make it unsuitable for cultivation. |
| ML – western portion | Bojac loamy sand | 2-6% | Gentle sloping, very deep, well drained can be used for cultivation; sloping, and erodibility limit its productivity. |
| ML – middle portion | Magotha fine sand loam | 0-2% | Nearly level, very deep, poorly drained hydric soils. This soil provides a suitable wildlife habitat. |
| ML –eastern and WI western portions | Chincoteague silt loam | 0-1% | Nearly level, very deep, very poorly drained hydric soils. This soil provides a suitable wildlife habitat. |
| WI – eastern portion | Chincoteague silt loam | 0-1% | Nearly level, very deep, very poorly drained hydric soils. This soil provides a suitable wildlife habitat. |
| WI – east of Chincoteague silt loam | Udorthents and Udipsamments | 0-35% | Nearly level to steep, very deep, and range from well drained to somewhat poorly drained. |
| WI – southern end | Fisherman Assateague fine sands complex | 0-35% | Nearly level to steep, very deep, moderately well, to excessively drained. This soil is used mainly for wildlife habitat and recreation. |

**TABLE 4-1**
**PREDOMINANT SOIL TYPES AT WALLOPS FLIGHT FACILITY**

| LOCATION | SOIL TYPE | TYPICAL SLOPES | DESCRIPTION |
|---|---|---|---|
| WI – depressions and areas associated with dunes and salt marshes | Fisherman Comacca fine sands complex | 0-6% | Very poorly to moderately well drained. |
| WI – central and western portions in depressions and on flats associated with dunes and marshes | Comacca fine sand | 0-2% | Nearly level, very deep, very poorly drained. The soil is used mainly for wildlife habitat and recreation. |
| WI – eastern portion | Assateague fine sand | 2-35% | Gently to steeply sloping, very deep, excessively drained. This soil is rarely flooded and is used primarily for wildlife and recreation. |
| WI – eastern portion | Beaches | | Moderately sloping and used mainly for wildlife habitat. |
| (Reference 4) | | | |

#### 4.1.1.4 Existing Land Use

The Main Base, Mainland, and most of Wallops Island are zoned industrial by Accomack County (Reference 3). The marsh area between the Mainland and Wallops Island is not included in the industrial zoned area and is classified as marshland in the county's plan.

The primary functions of the range control center, administrative offices, aircraft operations, and data acquisition facilities on the Main Base are assembling sounding rocket components, managing the airport, and launching balloons. Antennae and transmitters occupy a large portion of the Mainland area. Rocket launch facilities and Navy testing facilities dominate the Wallops Island area. Refer to Chapter 2.0 of this document for a more complete description of the installations and ongoing operations.

Wallops Flight Facility is surrounded by rural farmland and small villages. Horntown, with approximately 1,446 acres (578.4 hectares), is located approximately 2.5 miles (4 kilometers) to the north of the Main Base; Wattsville, with approximately 826 acres (330.4 hectares), 1 mile (1.6 kilometers) to the west; and Atlantic, with approximately 459 acres (183.6 hectares), 2.75 miles (4.4 kilometers) to the southwest. These villages have populations of less than 500 people each.

The Town of Chincoteague on Chincoteague Island, Virginia, is the largest of the surrounding communities. Section 4.3, Social and Economic Factors, contains information regarding the Town of Chincoteague's businesses and population. Under an easement agreement with NASA, the Town of Chincoteague operates a series of drinking water production wells to the east of Runway 04-22 of the Wallops Airfield. Refer to Section 4.1.3.2, Groundwater, for further information regarding groundwater wells. The areas surrounding Wallops Flight Facility are regulated under a County government and several town councils.

The Mainland is bordered by agricultural land to the north, south, and west, and by marshland to the east. Agricultural land borders Main Base to the south, west, and north. (Reference 3). Corn, wheat, soybeans, cabbage, potatoes, cucumbers, and tomatoes are examples of the commodities produced on the surrounding farms. The Main Base is bordered by marshland to the northeast, east, and southeast. Most of the land surrounding the Main Base and Mainland has some prime or unique farmlands based upon the soil classification. Portions of the Main Base can be classified as prime farmland because of their Bojac fine sandy loam soils. The Mainland and Wallops Island do not have prime farmland areas as classified by soil type.

Rural residential land borders the Main Base to the southwest. Small businesses are scattered throughout the agricultural area. These businesses include farms, gas stations, retail stores, markets and restaurants. Hotels and motels can be found on Chincoteague Island. The Town of Chincoteague, located to the east of the Main Base, has a large tourist population during the summer. The influx of people has led to development of summer season tourist businesses in the Chincoteague area.

Wallops Visitor Center, located on Route 175, gives tourists an understanding of Wallops Flight Facility's functions. Wallops Flight Facility has given permission to the Marine Science Consortium to moor boats at the dock located near the Visitor Center. The Marine Science Consortium, established in 1965, is a non-profit educational corporation of 14 universities. The Marine Science Consortium facilities are located near the Main Gate of the Main Base, and include housing for students, staff, and faculty; a cafeteria; classrooms/laboratories; recreation areas; administration offices; vehicles; research vessels; and oceanographic equipment. The MSC uses the Chincoteague National Wildlife Refuge, Assateague Island National Seashore, and Wallops Flight Facility for access to salt and freshwater marshes, estuaries, and barrier island beaches and dunes. The Wallops Island National Wildlife Refuge is located adjacent to the Wallops Visitor Center and is under the jurisdiction of the U.S. Department of Interior, Fish and Wildlife Service. The general public is restricted from using the refuge.

#### 4.1.1.5 Future Land Use

Future development on the Main Base is controlled by Wallops Flight Facility due to soil contamination in the following locations: (1) the former Fire Training area, (2) old Aviation Fuel Tank Farm area, (3) the Scrapyard area, and (4) the former location of a leaking PCB transformer (Reference 69). Investigations and remediations are ongoing or completed in these affected areas. Figure 4-2 shows the approximate locations of these restricted areas.

Various NASA organizations review proposed development or rehabilitation projects at Wallops Flight Facility. NASA also reviews proposals for partner activities. Wallops Flight Facility operations undergo scrutiny for compliance with environmental laws and impacts on the ecosystem.


**Figure 4-2**

**Limited Land Use Areas**

### 4.1.2 Energy Usage

#### 4.1.2.1 Introduction

Energy use data for Wallops Flight Facility is maintained by the Facilities Management Branch. Consumption of electrical power and fuel oils is inventoried and recorded.

Electrical service is supplied by Connectiv Power Delivery. Wallops Flight Facility is supplied with electric power on separate lines for Main Base, Mainland, and Wallops Island. During low-voltage periods, Wallops Flight Facility supplements electricity with generators as part of a peak-load reduction program. Facilities Management Branch operates backup power generators when interruptions to Connectiv's services occur. Facilities Management Branch also sets up short-term power services throughout the facility when needed for special projects. See Section 2.5.1, Utilities, for additional information on electricity. Heat is provided to buildings at Wallops Flight Facility by a combination of heat pumps, electric heat, or steam heat generated by boilers using Number 2 or Number 6 fuel oils. Conservation measures currently employed at Wallops Flight Facility include installation of high-efficiency heating units and automatic shutdown of some units on nights and weekends.

#### 4.1.2.2 Appropriation

Electricity usage data in kilowatt-hours (kwh) is presented in Table 4-2 for 1998 for the Main Base, Wallops Island Launch Area, the Wallops Visitor Center, the Boresite Tower, and for Navy housing. In 1998, the Main Base and Wallops Island were responsible for approximately 95% of Wallops Flight Facility's electrical consumption.

**TABLE 4-2**
**ELECTRICITY USAGE DATA FOR WALLOPS FLIGHT FACILITY (kwh)**

| | FISCAL YEAR 1998 | % OF TOTAL kwh | 1999 1ST QUARTER | % OF TOTAL | S |
|---|---|---|---|---|---|
| Main Base | 18,146,400 | 42.68% | 4,188,000 | 42.70% | |
| Launch Area | 21,753,600 | 51.12% | 5,040,000 | 51.38% | |
| Wallops Visitor Center | 193,360 | 0.46% | 32,880 | 0.34% | |
| Boresite Tower | 12,033 | 0.03% | 2,009 | 0.02% | |
| Navy Housing | 2,403,600 | 5.71% | 546,000 | 5.57% | |
| Total | 42,508,993 | --- | 9,808,889 | --- | |

(Reference 63)

Oil usage in 1998 totaled 162,965 gallons (616,890 liters) of Number 2 oil and 323,731 gallons (1,225,455 liters) of Number 6 oil. First quarter usage during 1999 totaled 44,494 gallons (168,428 liters) of Number 2 oil and 119,654 gallons (452,940 liters) of Number 6.

Air and ground transportation fuel use data are presented in Table 4-3. Ground transportation fuels used in 1998 consisted primarily of gasoline (66 percent), but also included diesel fuel (34 percent). During the first quarter of 1999, approximately 34 percent of the ground transportation fuel consisted of diesel, with the remainder being gasoline. Air transportation fuel

used in 1998 and the first quarter of 1999 was almost entirely JP-5 (greater than 99 percent). Aircraft 100/130 fuel accounted for less than 1 percent of the air transportation fuel. Logistics is responsible for fuel inventory. Jet Propellant Thermally Stable (JPTS) fuel is only used when the U2 aircraft is at Wallops Flight Facility. The U2 aircraft uses approximately 10,000 gallons of JPTS fuel per year. Table 4-4 presents Wallops Flight Facility airfield fuel systems.

**TABLE 4-3**
**TRANSPORTATION FUEL USAGE FOR WALLOPS FLIGHT FACILITY (GALLONS)**

| FUEL TYPE | FISCAL YEAR 1998 | % OF TOTAL GALLONS | 1999, 1ST QUARTER | % TOTAL GALLONS |
|---|---|---|---|---|
| GROUND TRANSPORTATION | | | | |
| Auto Fuel (gasoline) | 57,034 | 66 % | 14,259 | 66% |
| Diesel Fuel | 29,066 | 34 | 7,266 | 34 |
| Total Gallons | 86,100 | --- | 21,525 | --- |
| AIR TRANSPORTATION | | | | |
| Jet Fuel JP-5 | 311,087 | | 77,772 | |
| JPTS Fuel | <10,000 | | 0 | |

(Reference 63)

**TABLE 4-4**
**WALLOPS FLIGHT FACILITY AIRFIELD FUEL SYSTEMS**

| FUEL TYPES | DISPENSING EQUIPMENT | CAPACITY* | PUMP RATE (GPM) | STORAGE CAPACITY |
|---|---|---|---|---|
| JP-5 Fuel | 1 Truck | 6000 gallons | 200 | 100,000** |
| | 1 Truck | 5000 gallons | 200 | |
| JPTS Fuel | 1 truck | 5000 gallons | 200 | 20,000 |

*Useable Capacity
**5 interconnected 20K gallon tanks

(Reference 70)

### 4.1.3 Water Resources

#### 4.1.3.1 Surface Waters

Surface waters in the vicinity of Wallops Flight Facility are identified in Figure 4-1. These waters are saline to brackish and have tidal influences due to the coastal location. The surface waters in the vicinity of Wallops Flight Facility are designated as Class II (Estuarine Waters) by the Commonwealth of Virginia. The Atlantic Ocean, which lies to the east of Wallops Island, is designated as Class I (Open Ocean). These classifications include water quality standards for dissolved oxygen, pH, and maximum temperature. In addition, numerical water quality standards are applied according to water classification. For Class I and II waters, the saltwater numerical standards apply. These standards are listed in the Virginia Department of

Environmental Quality regulations 9 VAC 25-31-110. These standards, as well as effluent limitations on point source discharges, are mechanisms used by the Commonwealth of Virginia to protect and maintain surface water quality.

#### *4.1.3.1.1 Virginia Pollutant Discharge Elimination System Permit*

The Commonwealth of Virginia, in a Federally approved program, has the authority to issue Virginia Pollutant Discharge Elimination System permits (VPDES). A VPDES permit, issued by the Department of Environmental Quality, authorizes potential or actual discharge of pollutants from a point source to surface waters under prescribed conditions and limitations.

VPDES Permit No. VA0024457 was issued to Wallops Flight Facility by the Department of Environmental Quality on August 17, 1989, with the most recent renewal date being August 17, 1999. Three point source discharges are authorized by Permit No. VA0024457. These discharge locations, designated as outfalls 001, 003, and 301 are shown in Figure 4-4. A description of each discharge and the receiving stream is presented in Table 4-5. The associated limitations to regulate effluent quality established for each outfall are presented in Table 4-6.

**TABLE 4-5**
**OUTFALL DESCRIPTIONS – VPDES PERMIT NO. VA0024457**

| OUTFALL | DESCRIPTION | RECEIVING STREAM |
|---|---|---|
| 001 | FOTW receives sanitary wastes, discharge from cooling towers (N-159), and waste streams from the Circuit Board Etching Shop (F-8), the Antenna Etching Operation (F-8), and the Photo Processing Shop (E-2). | Little Mosquito Creek |
| 003 | Cooling water at Building F-10 and stormwater runoff. | Little Mosquito Creek |
| 301 | Near D-4, rainwater discharge pipe | Little Mosquito Creek |

(Reference 19)

#### *4.1.3.1.2 Wastewater*

Primarily, Main Base wastewater is collected in sanitary sewers and treated at the Federally Owned Treatment Works (FOTW). However, a few isolated buildings on the Main Base use septic systems. Wallops Island uses septic systems, and sanitary sewer, force main, and lift stations to pump wastewater to the Main Base Federally Owned Treatment Works. The Mainland currently uses septic systems only. The Wallops Visitor Center is served by a separate septic system.

The Main Base is serviced by a gravity sewage collection system, lift stations, and force mains that conveys the facility wastewater to a Federally Owned Treatment Works located in the northwest corner of the Main Base (Figure 1-3). The gravity collection system was rehabilitated in 1992. The new Federally Owned Treatment Works replaced the former 1940 Trickling Filter Plant in August 1999. The new treatment system provides primary, secondary, and tertiary treatment, ultraviolet disinfection, and sludge stabilization (Figure 4-3). Primary treatment includes grit removal bar screens and comminutors. Secondary treatment is accomplished by biological treatment and secondary clarifiers. Tertiary treatment is accomplished by sand filters. Prior to discharge, an ultraviolet system provides disinfection. Sludge stabilization is accomplished by aerobic digestion and drying beds prior to land fill disposal.

The discharge from the Main Base Federally Owned Treatment Works is designated under the VPDES permit as Outfall 001 (Figure 4-4). The receiving stream is an unnamed tributary of Little Mosquito Creek. The effluent limitations established by the VPDES permit are summarized in Table 4-6.

**TABLE 4-6**
**EFFLUENT LIMITATIONS BY OUTFALL – VPDES PERMIT NO. VA0024457**

| EFFLUENT CHARACTERISTICS | FREQUENCY | 001 | 003 | 301 |
|---|---|---|---|---|
| Flow (MGD) | Monthly Average | NL* | NA** | NL |
| | Weekly Average | NA | NA | NA |
| | Minimum | NA | NA | NA |
| | Maximum | NL | NL | NL |
| CBOD5 (mg/l; kg/d) | Monthly Average | 10 mg/l - 11.4 kg/d | NA | NA |
| | Weekly Average | 15 - 17.0 | NA | NA |
| | Minimum | NA | NA | NA |
| | Maximum | NA | NA | NA |
| Total Suspended Solids | Monthly Average | 10 mg/l - 11.4 kg/d | NA | NA |
| (mg/l; kg/d) | Weekly Average | 15 - 17.0 | NA | NA |
| | Minimum | NA | NA | NA |
| | Maximum | NA | NL | 60 |
| Total Kjeldahl Nitrogen (TKN) | Monthly Average | 3.0 mg/l - 3.4 kg/d | NA | NA |
| (mg/l; kg/d) | Weekly Average | 4.5 - 5.1 | NA | NA |
| | Minimum | NA | NA | NA |
| | Maximum | NA | NA | NA |
| pH (standard units) | Monthly Average | NA | NA | NA |
| | Weekly Average | NA | NA | NA |
| | Minimum | 6.0 | 6.0 | 6.0 |
| | Maximum | 9.0 | 9.0 | 9.0 |
| Fecal Coliform (N/CML) | Monthly Average | 200 | NA | NA |
| | Weekly Average | NA | NA | NA |
| | Minimum | NA | NA | NA |
| | Maximum | NA | NA | NA |
| Chronic Toxicity (Tuc) | Monthly Average | NA | NA | NA |
| | Weekly Average | NA | NA | NA |
| | Minimum | NA | NA | NA |
| | Maximum | 1.754 | NA | NA |
| Dissolved Oxygen (mg/l) | Monthly Average | NA | NA | NA |
| | Weekly Average | NA | NA | NA |
| | Minimum | 5.5 | NA | NA |
| | Maximum | NA | NA | NA |
| Total Petroleum Hydrocarbons | Monthly Average | NA | NA | NA |
| (mg/l) | Weekly Average | NA | NA | NA |
| | Minimum | NA | NA | NA |
| | Maximum | NA | NL | 15 |

*NA = Not Applicable **NL = No Limit, however, reporting is required

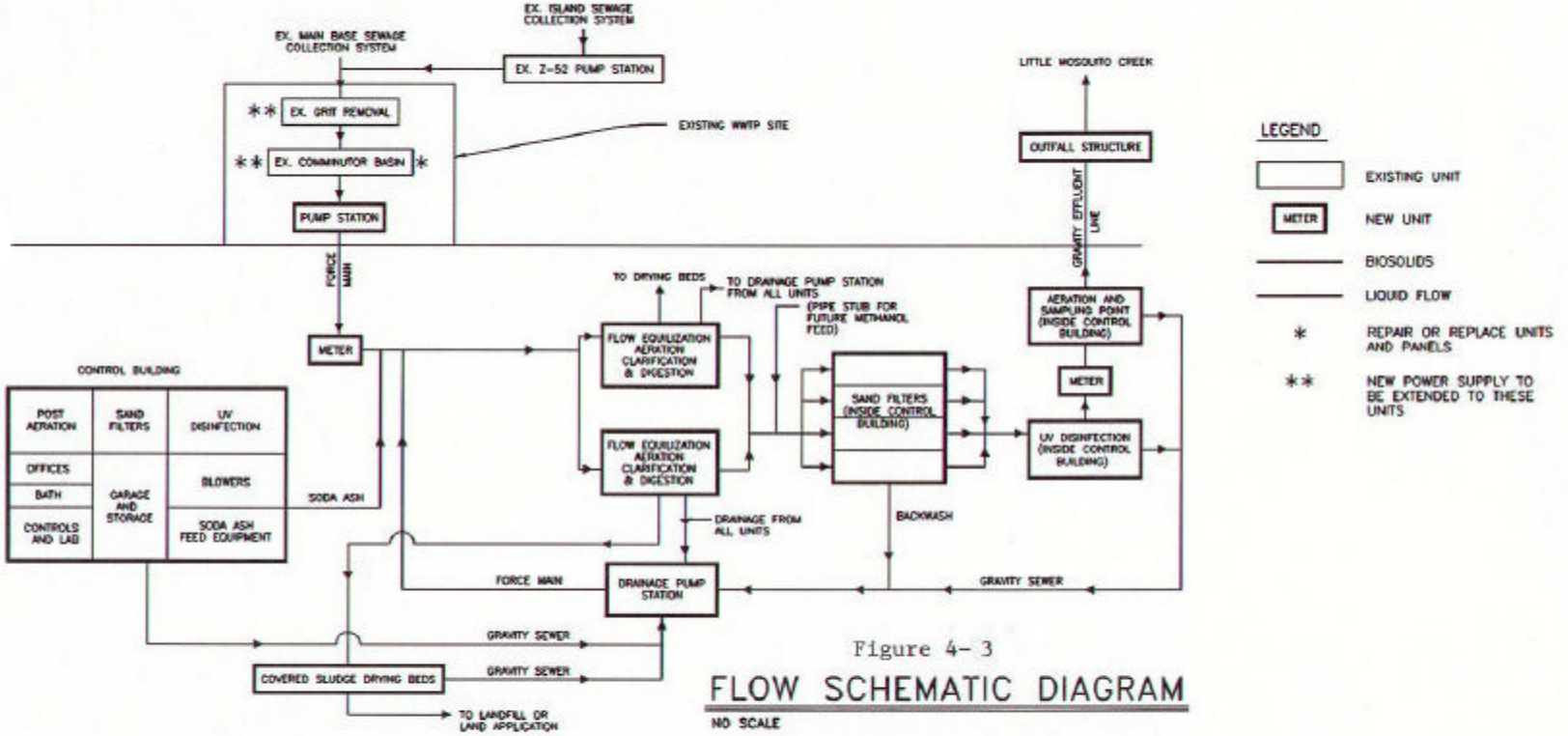



Figure 4-3

FLOW SCHEMATIC DIAGRAM

NO SCALE

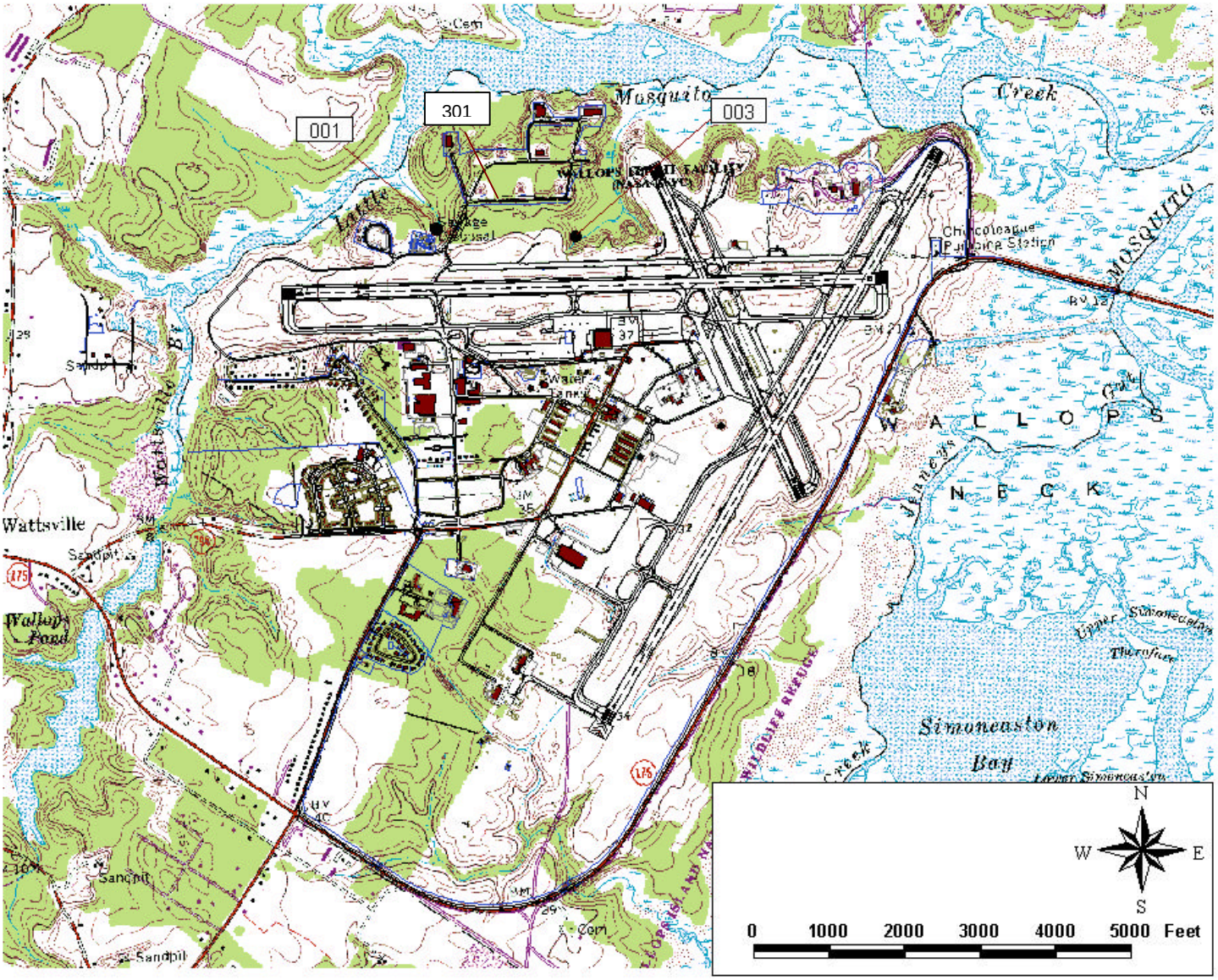



**Figure 4-4**
**Outfall Locations – Main Base**
**Stormwater Discharge Associated**
**With Industrial Activities**
**Wallops Flight Facility**

The Federally Owned Treatment Works has a design capacity of 300,000 gallons per day (gpd) (1,135,624 liters per day [lpd]). The current average daily discharge is approximately 70,000 to 80,000 gallons (264,979 to 302,833 liters). No flow limitation is established under the VPDES. However, the biological oxygen demand (CBOD5), total suspended solids (TSS), and Total Kjeldahl Nitrogen (TKN) effluent limitations are based on a flow of 300,000 gpd (1,135,624 lpd).

As a result of Outfall 001 discharging to a tributary of Little Mosquito Creek, a portion of this waterway is closed for shellfish harvesting by the Virginia Department of Health. The closure serves as a buffer zone to ensure protection of human health. Buffer zone closures in the vicinity of point source discharges are a standard practice to provide protection of public health. The area of closure required is determined through mathematical modeling by the Virginia Department of Health. For the period from December 1997 through May 1999, one exceedance of the fecal coliform limit was reported for Outfall 001. This occurred during July 1998, during a period of low flow and extremely high temperatures.

Buildings on the Mainland, the northern portion of Wallops Island, remote areas of the Main Base, and the Wallops Visitor Center are served by individual septic systems. The septic system locations are indicated on Figures 4-5(a) and 4-5(b) (Reference 49). A total of 19 septic systems are maintained by the Facilities Management Branch. The septic systems are pumped out biennially. The septage is transported to the Federally Owned Treatment Works for treatment. NOAA maintains one septic system with two tanks in series that receive sanitary discharges. Floor drains in the NOAA utility building are temporarily plugged. However, if the plugs are removed, the drains can discharge to the septic system. The NOAA septic systems are pumped out and the septage is disposed of by a private contractor (Reference 71).

#### *4.1.3.1.3 Storm drainage*

The Main Base has an extensive storm drain network that discharges into the Little Mosquito Creek to the north and west, and ultimately to Simoneaston Bay to the south and east. With the exception of several cross-culverts, storm drainage at the Mainland is primarily toward Bogues Bay, Hog Creek, and Cat Creek, which separate Wallops Island from the Mainland.

The northern portion of Wallops Island drains by overland flow to Bogues Bay and Chincoteague Inlet via Sloop Gut and Ballast Narrows. The central portion of the island site drains primarily to the west toward Bogues Bay. Cross-culverts under the main north-south road drain stormwater collected by culverts and ditches. Flap gates have been installed west of the north-south road to convey stormwater to Bogues Bay via Hog Creek (Reference 49).

A facility investigation was conducted in 1991 to identify stormwater discharges with potential permit requirements under the recently updated National Pollutant Discharge Elimination System (NPDES) regulations. Industrial activities requiring permits are identified by North American Industrial Code System (NAICS) formerly known as Standards of Industry Codes (SIC) codes. NASA, as identified by NAICS code 92711 for Space Research and Technology, is not included in the current NPDES regulations; however, industrial activities conducted at NASA facilities may be defined by a separate NAICS code and therefore require a NPDES permit for stormwater discharges. Based on the facility review, NASA submitted to the DEQ in September 1992, a

permit application for stormwater discharges associated with industrial activities. The permit application identified 14 such outfalls. Outfall 002, for the lagoons on Wallops Island, has since been closed. Three of the identified outfalls are permitted under the current VPDES Permit No. VA0024457, and are not included in the stormwater permit application. Table 4-5, Figure 4-4, and Figure 4-7 provide further information on these outfalls.

Several additional areas on the Main Base and Wallops Island were identified as industrial activities where stormwater discharges would require a permit. However, due to the lack of stormwater collection and conveyance systems, these areas are considered non-point sources and permitting is not currently required. The non-point source areas identified were the scrap yards at Buildings N-222 and B-31, the Used Oil Staging Facility at Building N-223, and the sludge drying beds. These sites are identified in Figure 4-6. In addition, the service area at Hangar N-159 drains to a swale with no outlet to surface waters, thereby eliminating the need for permitting.

In addition to monitoring required as part of the VPDES permit, some sampling of surface waters and stormwater runoff has been completed at Wallops Flight Facility. Several site investigation reports document limited surface water sampling (Reference 69, 110). Many of the areas investigated are non-point source areas with no direct connection to surface water. Other areas discharge runoff in the vicinity of the point source discharges as permitted under the VPDES permit. No significant impacts to surface water have been identified at Wallops Flight Facility to date.

Generally, sufficient data is available to characterize the existing background water quality in the vicinity of Wallops Flight Facility. However, the tidal nature of the surrounding surface waters and the migratory nature of organisms in these ecosystems make background characterizations difficult. Data collected to date has been used primarily for limited site investigation purposes.

### 4.1.3.2 Groundwater

#### *4.1.3.2.1 Geologic Setting*

The water-bearing formations within the Wallops Flight Facility area consist of sedimentary units, ranging in age from Cretaceous to Quaternary. The two uppermost stratigraphic units, the Yorktown Formation and the overlying Columbia Group, are the most important water supply formations for agricultural, domestic, public, and industrial uses.

The Yorktown Formation is the uppermost unit in the Chesapeake Group. The formation consists of fine to coarse, greenish gray, glauconitic quartz sand, which is clayey, silty, and in part, shelly. The formation occurs at depths of 60 to 140 feet (18.2 to 42.7 meters) in Accomack County (References 15, 58).

The Columbia Group consists of sand, sandy clay, and minor amounts of gravel deposited during the sea level fluctuations in the Pleistocene epoch (Reference 15). Figure 4-8 presents a south-north geologic cross-section from the Assawoman Research Station to the Captain Cove area, highlighting the hydrogeology of the general vicinity.

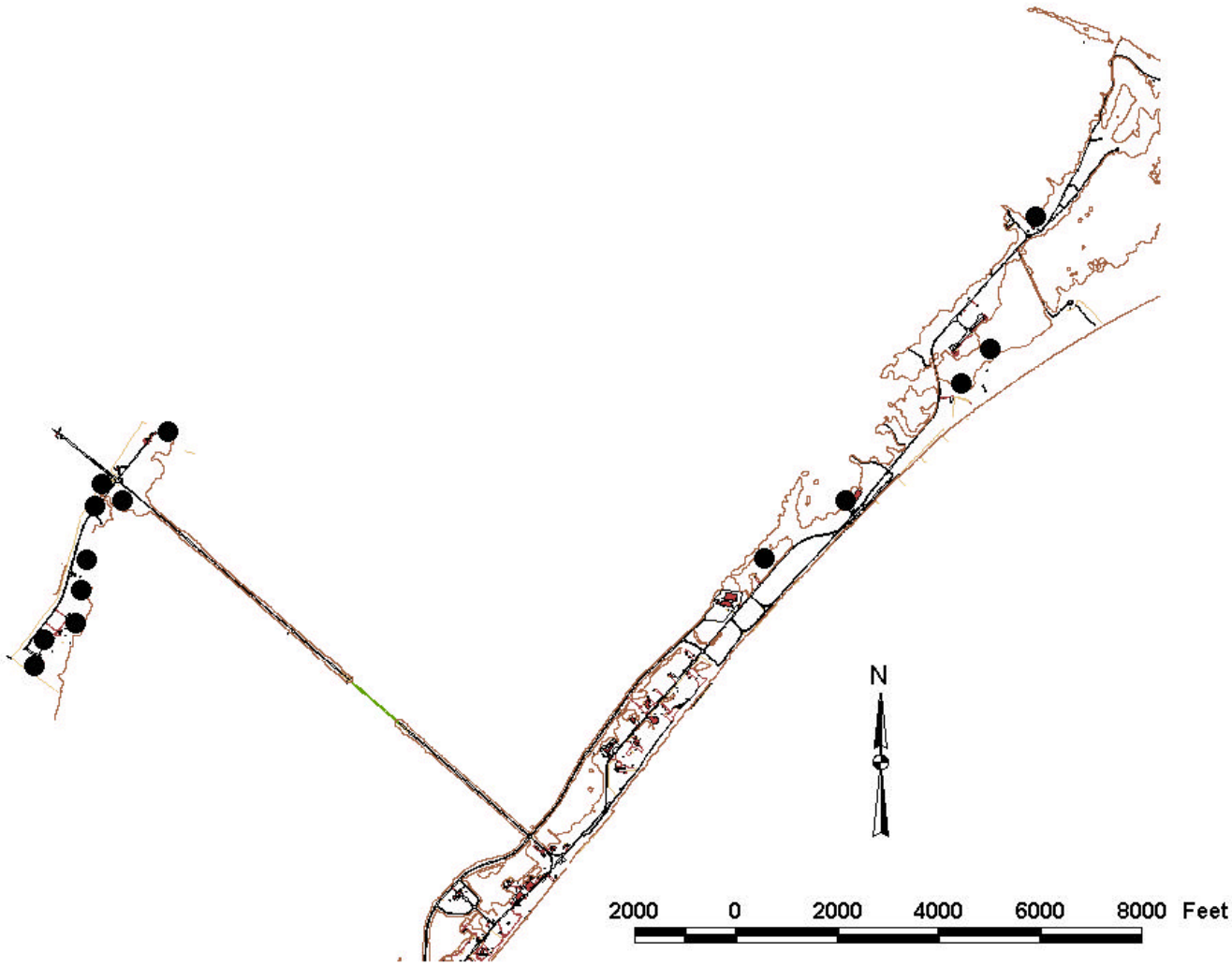



**Figure 4-5 (a)**
**Mainland and Island Septic Systems**

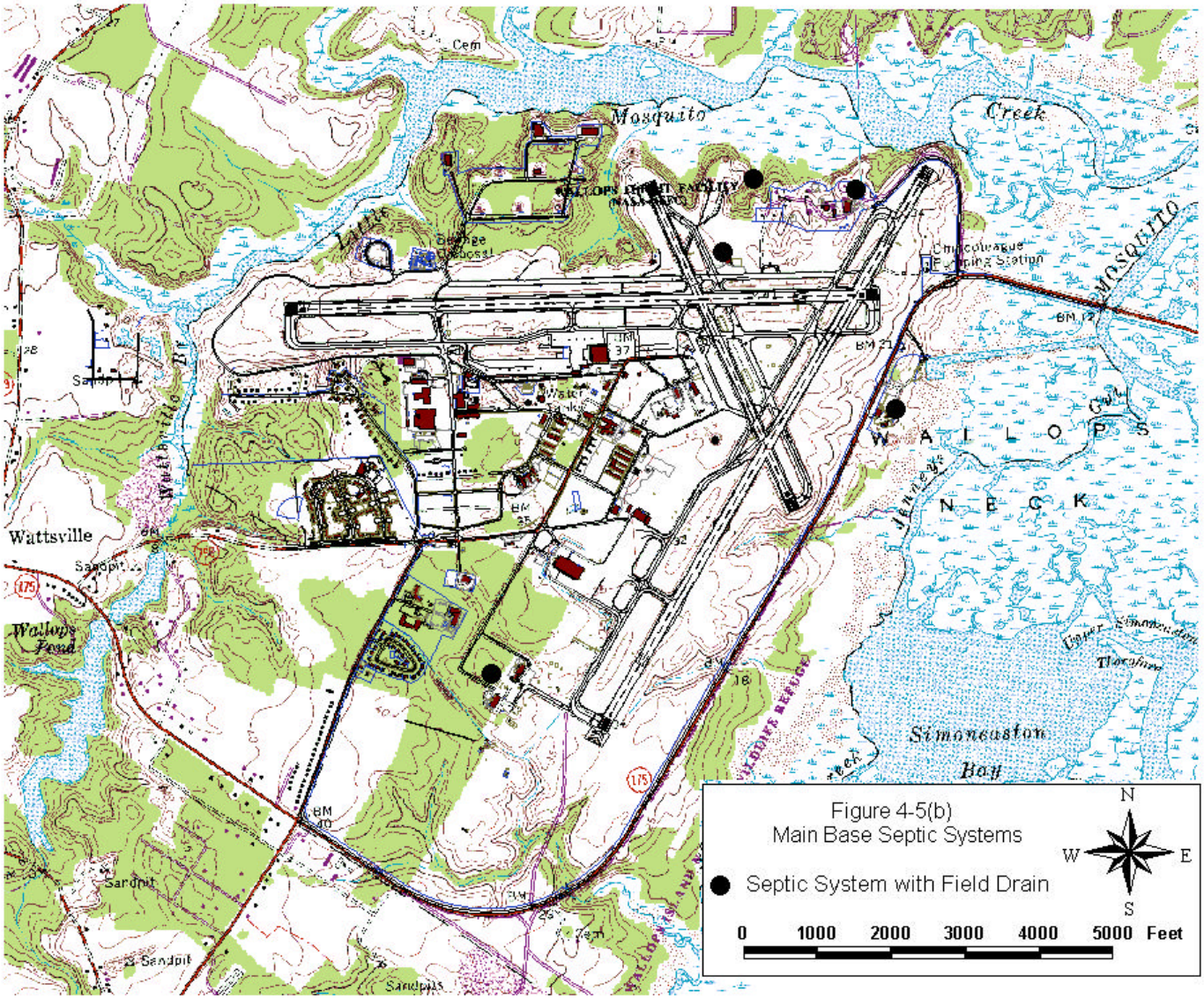
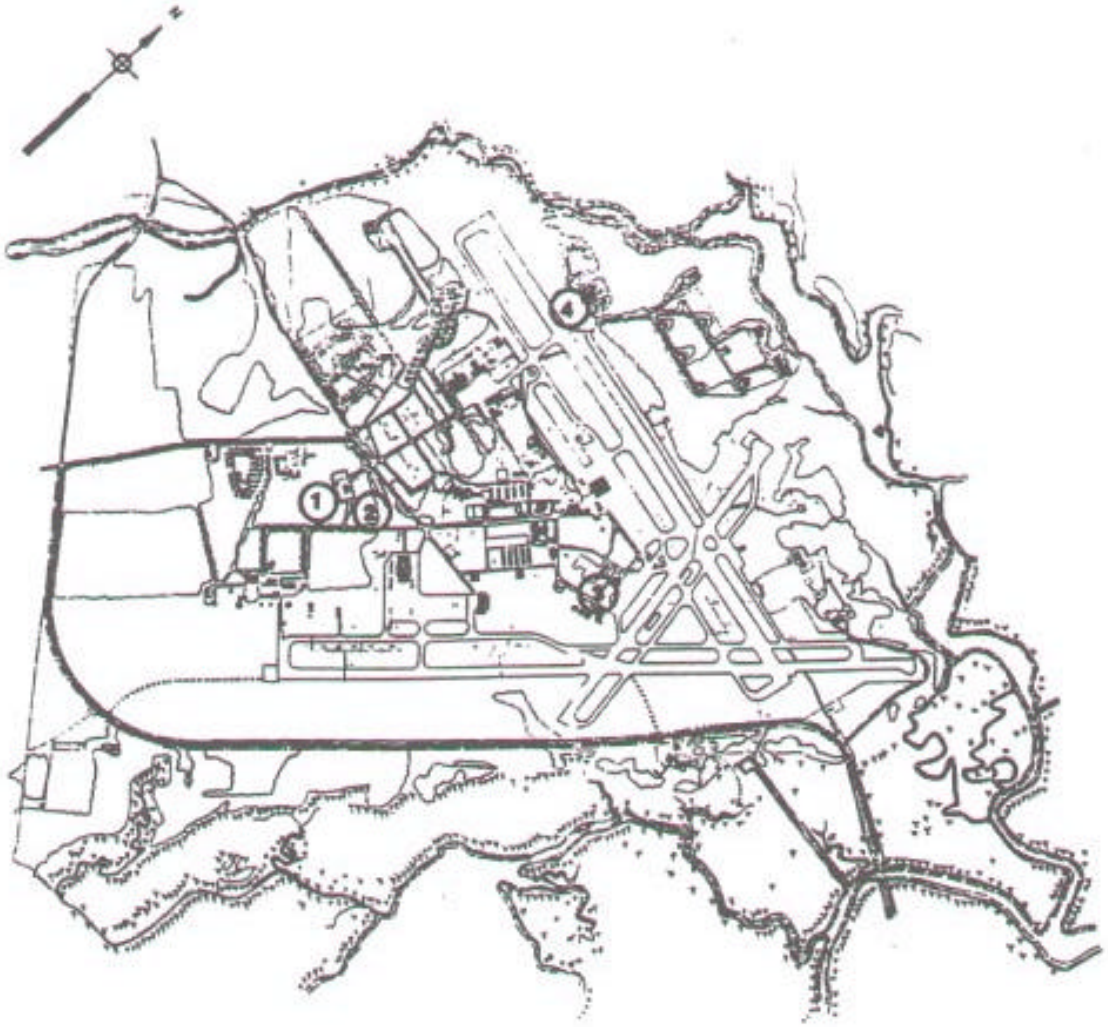



**Figure 4-5 (b)**
**Main Base Septic Systems**




**NON - POINT SOURCE AREAS:**

1 SCRAPYARD - BUILDING N - 222
2 HAZARDOUS WASTE STORAGE FACILITY - BUILDING N - 223
3 SCRAPYARD - BUILDING B - 31
4 SLUDGE APPLICATION YARDS (DRYING BEDS)

**NASA**
**WALLOPS FLIGHT FACILITY**

Figure 4-6
NON - POINT SOURCE AREAS ASSOCIATED WITH INDUSTRIAL ACTIVITIES
WALLOPS FLIGHT FACILITY

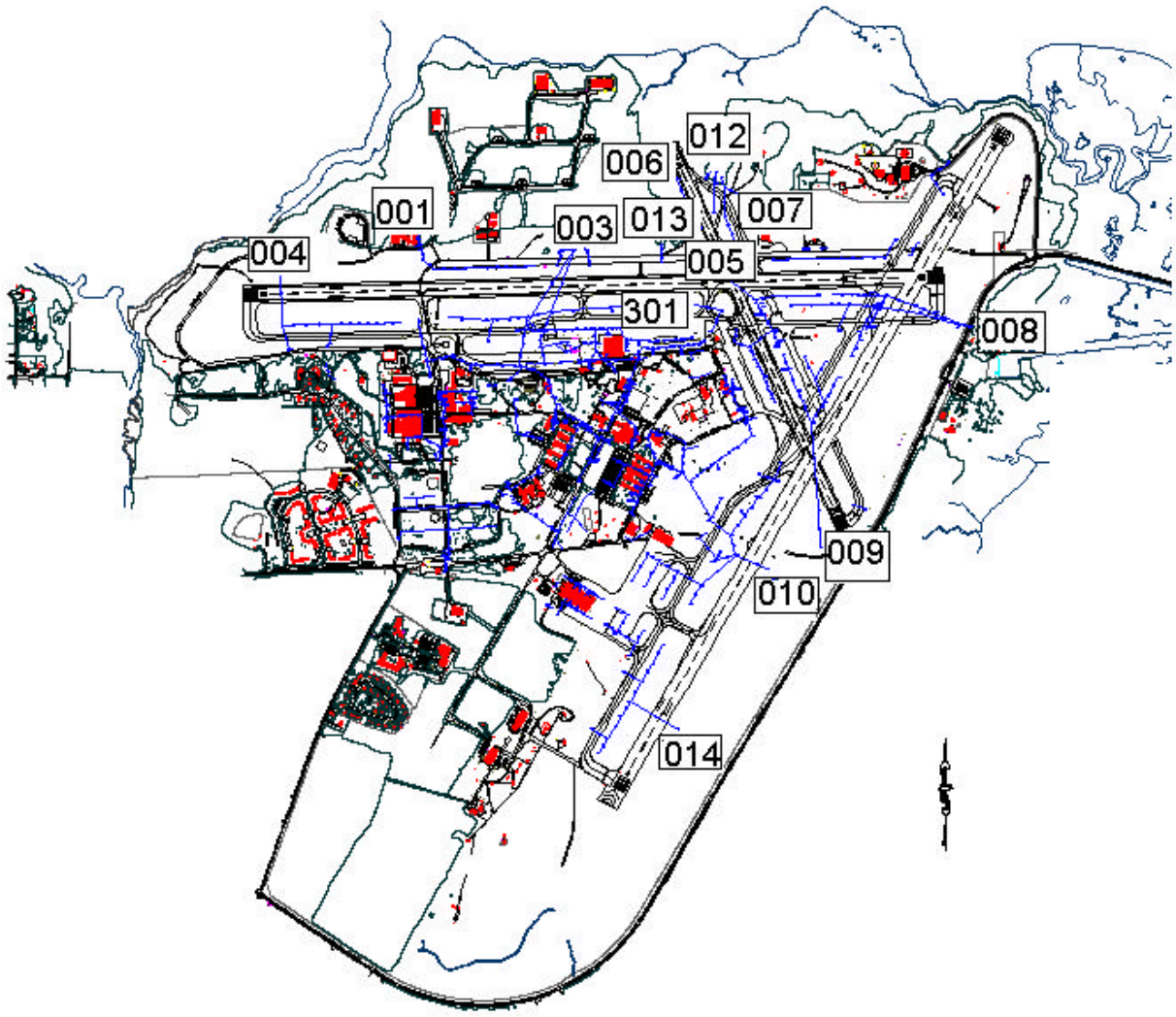



**Figure 4-7**

**Outfall Locations – Main Base**
**Storm Water Discharge Associated**
**With Industrial Activities**
**Wallops Flight Facility**

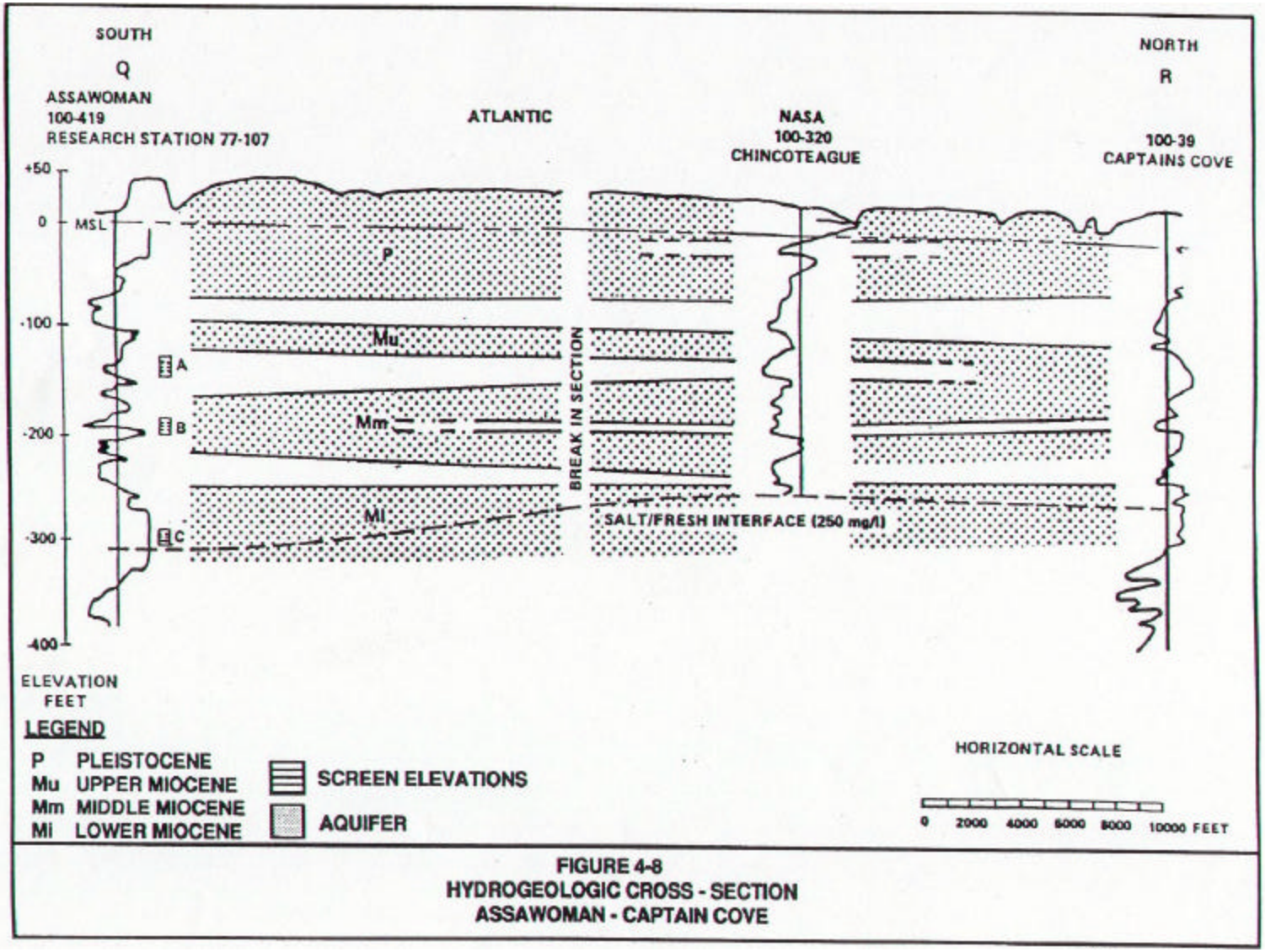



FIGURE 4-8
HYDROGEOLOGIC CROSS - SECTION
ASSAWOMAN - CAPTAIN COVE

#### *4.1.3.2.2 Hydrogeology*

The Virginia DEQ identified four major aquifers on the Eastern Shore of Virginia: the Pleistocene aquifer (Columbia Group) and the three separate units of Miocene aquifers in the Yorktown Formation (Reference 17).

The water table aquifer, known as the Pleistocene aquifer, is unconfined and typically overlain by wind-deposited beach sands, silts, and gravel. The aquifer occurs between depths of 5 and 60 feet (1.5 to 18.3 meters) below the ground surface. The water table ranges from depths of 0 to 30 feet (0 to 9.1 meters) below the ground surface. Groundwater flow is generally east and north toward nearby creeks and the marsh area that separates Chincoteague Island from the mainland (Reference 58).

The top of the shallowest confined Miocene aquifer of the Yorktown Formation at Wallops Flight Facility is found at depths of approximately 100 feet (30.5 meters) below the ground surface. It is separated from the overlying Pleistocene aquifer by a 20 to 30 foot (6.1 to 9.1 meters) confining layer (aquitard) of clay and silt. The Miocene aquifers are classified as the upper, the middle, and the lower Miocene aquifers. Correspondingly, each Miocene aquifer is overlain by the upper, middle, and lower Miocene confining units. Potable water supply wells for both the Town of Chincoteague and Wallops Flight Facility are screened at the upper and middle portions of the Miocene aquifers, from depths less than 150 feet (45.7 meters) below ground surface (References 58, 94). Five in-service supply wells owned by NASA and 5 under easement to the Town of Chincoteague are screened in the Miocene aquifer.

In general, the water table (Pleistocene) aquifer on the Delmarva Peninsula is recharged by surface waters or infiltration of precipitation. The confined aquifers are recharged by the same process, but from more distal areas located beyond the immediate vicinity of the study area. The annual average rainfall for Wallops Flight Facility is 36.8 inches (93.5 centimeters) with an annual net precipitation of 14 inches (35.6 centimeters) (Reference 69). Recent aquifer tests estimated hydraulic conductivity values ranging from approximately 80 to 200 feet/day (24.3 to 61 meters/day) and specific yield values from 0.01 to 0.13 for the unconfined aquifer (Reference 66). These values are typical of unconfined aquifers with mainly sand units, and demonstrate the ease of recharge from surface water and/or precipitation. These tests also showed that there was no significant vertical leakage through the aquitard below the unconfined aquifer. The confined aquifers are likely to be recharged laterally from an area with greater vertical leakages. Aquifer tests performed on the upper and middle Miocene aquifers estimated a transmissivity range of 8,500 to 14,500 gpd per foot (gpd/ft) (105,525 to 180,015 lpd/m), a storativity of ±0.003, and a vertical leakage rate of 0.0352 ft/day (0.0107m/day) for the upper aquifer. The middle Miocene aquifer has a transmissivity of 4,000 gpd/ft (49,660 lpd/m) and a storativity range of 0.002 to 0.0002 (Reference 56).

#### *4.1.3.2.3 Groundwater Quality*

Previous evaluations of the two principal aquifers underlying Wallops Flight Facility indicated that the groundwater quality for the Pleistocene and Miocene aquifers is good, though moderately hard and with little or no fluoride present. Most shallow wells and a few deep wells located within the tidal areas show evidence of brackish water due to saltwater intrusion. Localized iron problems have also occurred throughout the general area (Reference 56).

Studies conducted in 1991 have reported the frequent incidence of high nitrate levels in shallow wells drawing water from the Pleistocene aquifer at Wallops Flight Facility. The United States Environmental Protection Agency (USEPA) Maximum Contaminant Level (MCL) groundwater drinking water standard for nitrate is 10 milligrams per liter (mg/l). Eight samples from shallow wells in the vicinity of Building F-16 recorded high levels of nitrate, ranging between 7.27 and 11.5 mg/l (Reference 37). Additionally, two NASA shallow wells located on the Mainland have been retired and replaced with deeper wells due to the high levels of nitrate (Reference 54). The potential nitrate contaminant sources in the general area include sewage, fertilizers, precipitation, and landfills. Deeper supply wells tapping water from the Miocene aquifers have shown no evidence of nitrate contaminants (Reference 17).

In 1989, petroleum hydrocarbon and lead contaminants were detected in monitoring wells located at the Main Base in the vicinity of the old Aviation Fuel Tank Farm. During a spring of 1991 sampling episode, volatile organic compounds (VOC) were detected at or above detection limits in eight wells around the old Aviation Fuel Tank Farm (Figure 4-9(a) and 9(b)). Elevated values of volatile organic compounds were obtained in three wells (MW5S, MW5D and MW17) ranging from 21 to 730 µg/l (or parts per billion [ppb]) for benzene, and 940 to 52,000 µg/l for toluene. Monitoring well 17 also showed a dissolved lead value (230 µg/l) above maximum allowable contaminant level. The current USEPA Maximum Contaminant Levels are 5 µg/l for benzene, 1000 µg/l for toluene, and 15 µg/l for lead. Table 4-11 shows the laboratory results for some selected wells within the vicinity of the old Aviation Fuel Tank Farm. The source of contamination, numerous underground storage tanks and the associated pipes were removed from the site in October 1991. Since removal of the underground storage tanks, contaminant concentrations at the old Aviation Fuel Tank Farm monitoring wells have been declining. Table 4-7 describes contaminant levels discovered around the old Aviation Fuel Tank Farm.

A 1989 sampling event at the former Fire Training Area, former Waste Oil Dump, and Scrapyard indicated compounds in excess of USEPA Maximum Contaminant Levels. The presence of 1,2 dichloroethene (10 µg/l in well MW2S) and carbon tetrachloride (6 µg/l in well MW2S) were reported in groundwater at the former Fire Training Area. USEPA Maximum Contaminant Levels are currently 5 µg/l for both carbon tetrachloride and 1,2 dichloroethene. Levels of lead ranging from 88 to 131 µg/l were also reported in unfiltered groundwater samples obtained from wells at the former Waste Oil Dump. Chromium levels ranged from 96 to 116 µg/l in unfiltered groundwater samples at the former Waste Oil Dump area and at the Scrapyard (Building N-222). The Maximum Contaminant Level for chromium in water is currently 100 µg/l. The high levels of chromium and lead reported in groundwater may relate to their natural occurrence in the general area. Laboratory data on filtered groundwater samples are presently unavailable for these areas. Table 4-8 describes the 1991 sampling results.

**TABLE 4-7**
**GROUNDWATER MONITORING WELL CONTAMINANT LEVELS (µg/l)**

| Well | Benzene | Toluene | Lead |
|---|---|---|---|
| USEPA Levels | 5 | 1000 | 15 |
| MW5S | 730 | 19,000 | Below Detection |
| MW5D | 570 | 940 | Below Detection |
| MW17 | 500 | 48,000 | 230 |

**TABLE 4-8**
**ANALYTICAL DATA (µg/l) ABOVE DETECTION LIMITS FOR GROUNDWATER SAMPLES DURING SPRING 1991 FIELD INVESTIGATIONS**

| Well | Ethyl Benzene | Total Lead | Xylene | Benzene | Toluene | 1,1,1-Trichloroethane | 1,2-Dichloroethane |
|---|---|---|---|---|---|---|---|
| MW6 | <2 | <5 | <2 | 2 | <2 | <2 | <5 |
| MW10 | 16 | 110 | 21 | 89 | <2 | <2 | <5 |
| MW13 | <2 | <5 | <2 | <2 | 5 | <2 | <5 |
| MW14 | <2 | 11 | <2 | <2 | <2 | <2 | <5 |
| MW16 | 34 | 70 | 60 | 67 | <2 | <2 | <5 |
| MW5(d) | 240 | 360 | 570 | 940 | <10 | 13 | <5 |
| MW5(s) | 640 | 3,200 | 730 | 19,000 | <250 | <250 | 9 |
| MW17 | 500 | 2,600 | 500 | 48,000 | <500 | <500 | 93 |
| MW31* | 500 | 2,800 | 500 | 52,000 | <500 | <500 | 230 |
| MCLs | 700 | 10,000 | 5 | 1,000 | 200 | 5 | 50 |

* Duplicate of MW-17 (Reference 66)

As part of the efforts instituted to mitigate the adverse impact of contaminants on groundwater, 44 monitoring wells and two observation wells (Figures 4-9(a) and 4-9(b)) have been installed at the Main Base. A detailed site investigation of contamination at the former Fire Training area was initiated in 1993 and a 1997 *Metcalf & Eddy* Feasibility Study analyzed several alternative actions for the site. NASA has opted to impose institutional controls (restriction zones), intrinsic remediation and long term monitoring of this site. Construction of a groundwater remediation (extraction/reinjection) system at the old Aviation Fuel Tank Farm began in 1994 and should be operational in late 1999. Remediation of this site will be monitored for approximately 10 years until completed. Wells MW-41 through MW-44 were installed around the perimeter of the Main Base to monitor background and down-gradient compounds.

#### *4.1.3.2.4 Groundwater Appropriation*

Groundwater is the sole source of potable water for Wallops Flight Facility and the general vicinity. No major streams or other fresh surface water supplies are available as alternative sources of water for human consumption. A groundwater management planning program has been established by the Virginia Department of Environmental Quality for the entire Eastern Shore to ensure that an optimal balance exists between groundwater withdrawal and recharge rates. This balance helps to minimize the problems of water quality due to saltwater intrusion, aquifer de-watering, and well interference in the general area.

Groundwater appropriation within Wallops Flight Facility and its immediate vicinity can be categorized into agricultural, private, public, and industrial uses. Agricultural uses include crop irrigation and poultry. Based on reported 1990 water usage data in the Commonwealth of Virginia, Accomack County withdrew a total of more than 936 million gallons (3,543 megaliters) of water for crop irrigation (Reference 23). In addition, based on an estimate of 0.09 gallons (0.34 liters) of water per day per chicken (Reference 23), an estimated 234,000 gpd (885,787 liters) were used in 1990 for poultry production in the Eastern Shore area (Reference 37).

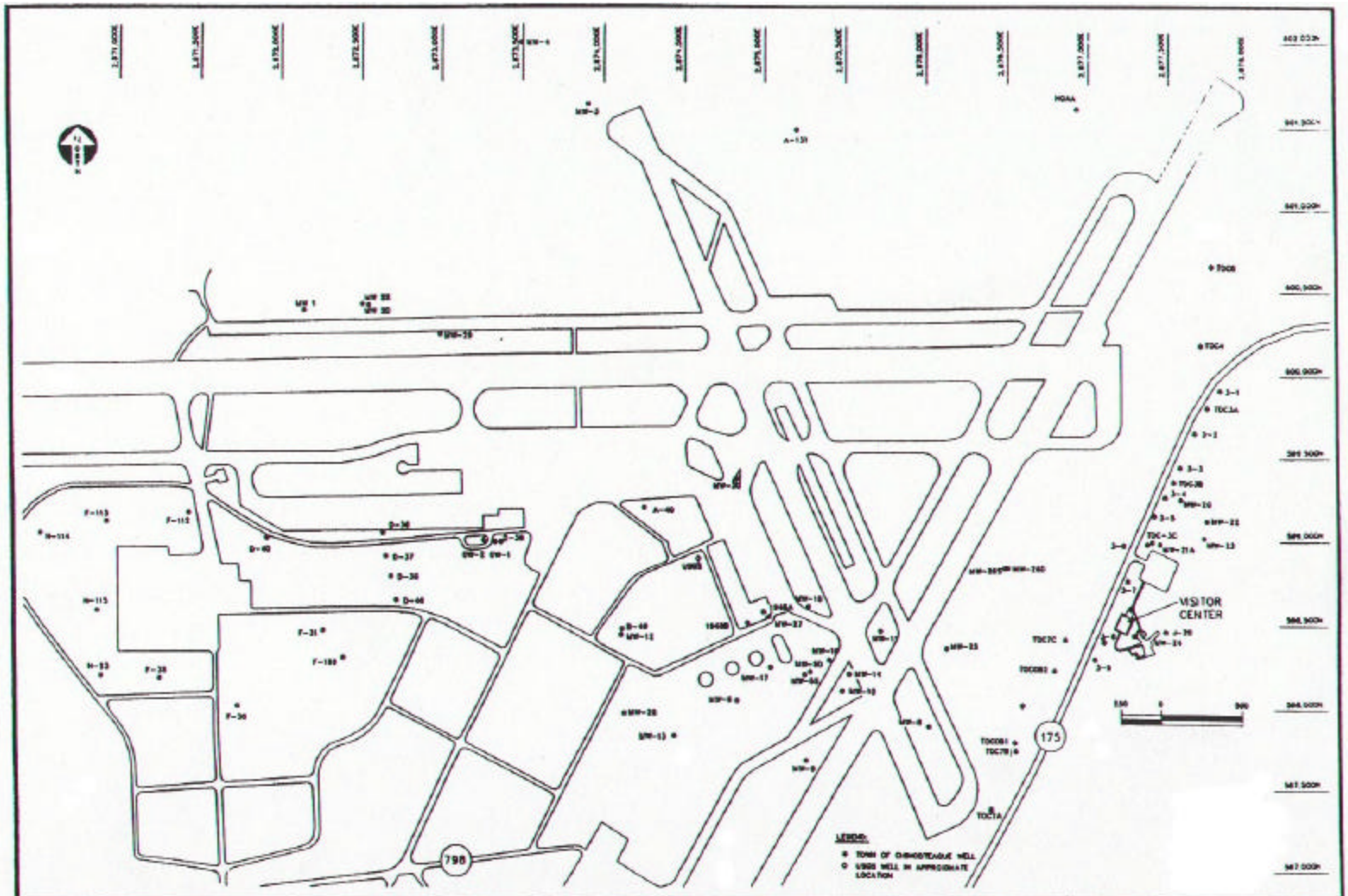



**FIGURE 4-9 (a)**
**NASA WALLOPS FLIGHT FACILITY**
**GROUNDWATER WELL LOCATIONS ON WWF MAIN BASE**

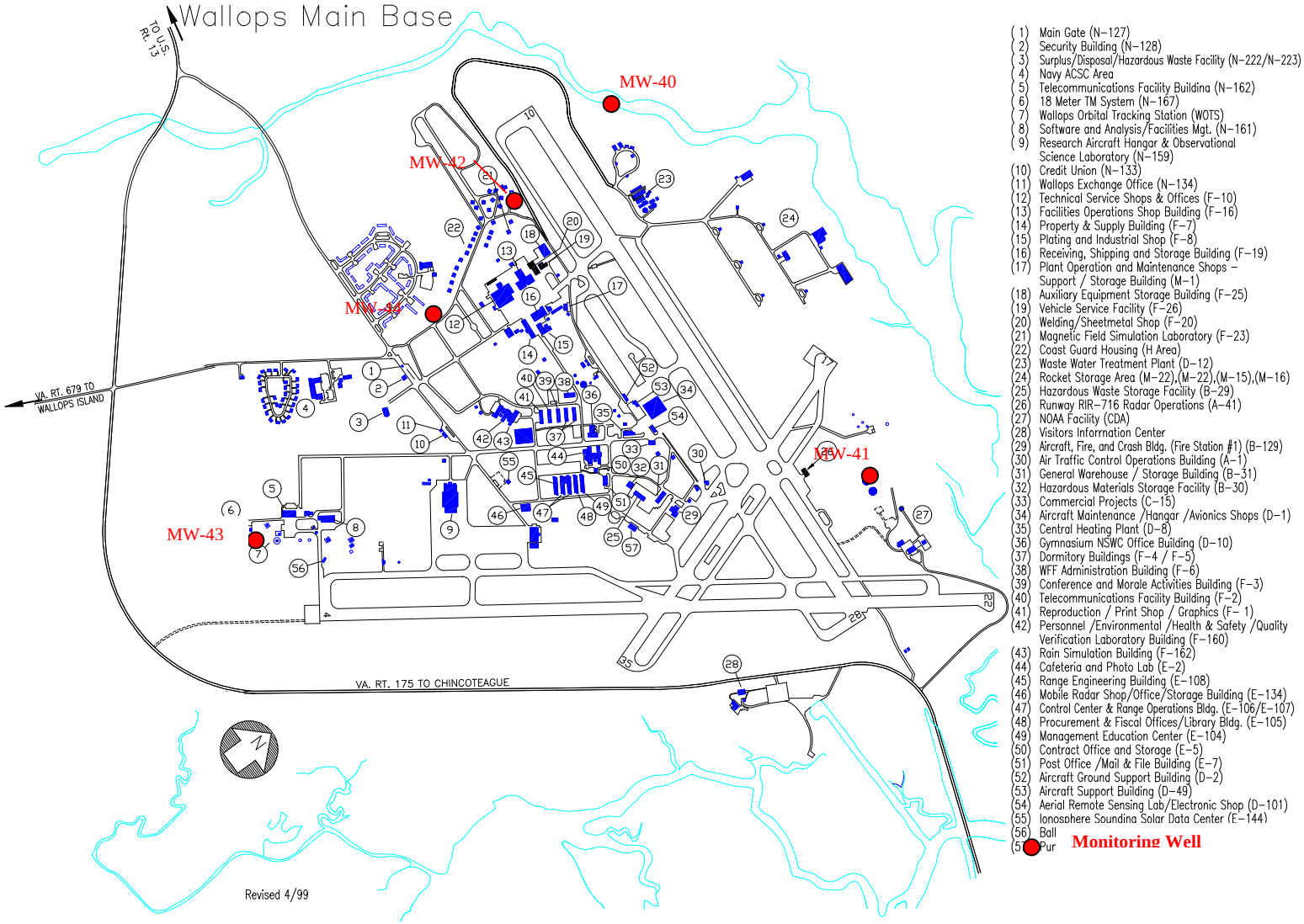



**Figure 4-9 (b)**
**Locations of Monitoring Wells 40 – 44 on MB**

Industrial and public water users withdrawing at least 10,000 gpd are required to obtain a DEQ (formerly SWCB) permit. Wallops Flight Facility is presently limited to approximately 8,200,000 gallons (31 megaliters) per month (Reference 25). Actual Wallops Flight Facility withdrawals are approximately 3,000,000 gallons (11.3 megaliters) per month. The Town of Chincoteague 1999 water usage data supplied by the Town of Chincoteague Public Works, indicates a total withdrawal of over 2,000,000 gallons (7.6 megaliters), annually, from wells located within Wallops Flight Facility property.

### 4.1.4 Wetlands and Floodplains

#### 4.1.4.1 Introduction

This section describes the wetlands and floodplain resources at Wallops Flight Facility to provide a baseline of information for future evaluations of projects that may affect wetland areas. The information found in this section will assist with a first-step evaluation of the wetlands at the facility, and is based on sources that include the 1981 National Wetland Inventory Maps (Reference 84) and the Accomack County Wetland Maps.

Wetlands include areas such as swamps, marshes, and bogs, and possess one or more of three essential characteristics:

- hydrophytic vegetation
- hydric soils
- wetland hydrology

Hydrophytic vegetation is vegetation or plant life adapted to growth and reproduction under periodically saturated root zone conditions during at least a portion of the growing season. The substrates to which these plants adapt are periodically oxygen deficient as a result of excessive water content and organically enriched soils. Hydrophytic vegetation identified at Wallops Flight Facility during previous wetland investigations (Reference 57) include the following: Saltmeadow Cordgrass (*Spartina patens*), Seaside Goldenrod (*Solidago sempervirens*), Marsh Elder (*Iva frutescens*), Common Reed (*Phragmites australis*), Groundsel-tree (*Baccharis halimifolia*), American Threesquare (*Scirpus americanus*), and Spike Rush (*Eleocharis ambigens*). Details of vegetation, including wetland species at Wallops Flight Facility, can be found in Section 4.2.1.2, Flora Species.

Hydric soils are saturated, flooded, or ponded during the growing season long enough to develop anaerobic conditions in the upper portion, and are generally poorly drained. The hydric soils in Accomack County are designated by the Accomack County Soil Conservation Service. Hydric soils known to occur in Accomack County near Wallops Flight Facility include the Cateret, Chincoteague, Magotha, Nimmo, and Polawana soils (Reference 5). The presence of hydric soils at a proposed project location is evaluated during wetland delineation.

Wetland hydrology is often the least exact and most difficult method of identifying a wetland area due to annual, seasonal, and daily fluctuations in hydrological factors. Numerous factors influence the wetness of an area, including precipitation, stratigraphy, topography, soil

permeability, and plant cover. All wetlands have at least a seasonal abundance of water which may result from direct precipitation, overbank flooding, surface water runoff due to precipitation or snow melt, groundwater discharge, or tidal flooding. Permanent or periodic inundation and soil saturation to the surface are the driving forces behind wetland formation.

The Department of the Army has prepared the *Corps of Engineers Wetland Delineation Manual* to provide Federal guidelines in wetland delineation techniques. The Manual presents the criteria for identifying each wetland characteristic. The criteria specified in this manual are Federally mandated and must be met for an area to be identified as a jurisdictional wetland for wetland permitting purposes. Any proposed development in wetland areas must be coordinated with the Accomack County Wetlands Board, the Virginia Marine Resources Commision, and the Army Corps of Engineers. Most proposed construction projects at Wallops Flight Facility, particularly on Wallops Island, will require a site-specific wetlands evaluation.

#### 4.1.4.2 Wetland Delineation and Classification

The National Wetlands Inventory maps are prepared by the United States Fish and Wildlife Service from United States Geological Survey quadrangle sheets using a stereoscopic analysis of high altitude aerial photographs. Wetland areas are classified based on vegetation, visible hydrology, and geography according to the *Classification of Wetlands and Deepwater Habitats of the United States.* The most recent National Wetlands Inventory maps for Wallops Flight Facility are shown in Figures 4-10(a) and 4-10(b). Since the key to the wetland symbols is so lengthy, the symbols have been provided on the following page (Figure 4-11) rather than on each map. Wetland delineation is the process of outlining a wetland area. The two general types of delineation methods are the off-site procedure and on-site procedure. Off-site procedures are performed in the office using existing information, while on-site procedures are employed in the field. Off-site procedures are used when an on-site inspection is unnecessary or as a first step before onsite work to improve field efficiency. The following items should be reviewed for available information:

- United States Geological Survey maps
- National Wetlands Inventory maps
- State wetland maps
- Local wetland maps
- Soil, Water, and Conservation District maps
- Aerial photos
- Site-specific information (plans and engineering designs)

The on-site procedure is required when the precise boundary of a wetland must not be violated. When on-site delineation is necessary, one of three methods described in the Federal Manual may be used, depending on the information needed or the complexity of the area. Those methods are routine, intermediate-level, and comprehensive.

The routine method is designed for areas equal to or less than 5 acres (2 hectares) in size, or larger areas with similar vegetation. For areas greater than 5 acres (2 hectares) in size or areas of any size that are highly diverse in vegetation, the intermediate level of comprehensive methods

should be applied. When detailed documentation of vegetation, soils, and hydrology is required, the comprehensive method should be employed. In cases where natural conditions make identification difficult, special procedures for problem area determinations, which are subsets of the three on-site methods, should be used. The appropriate method for delineating individual wetlands within an area of concern should be applied. A combination of determination methods may be required over an entire site.

### 4.1.4.3 Wetland Resources

Wetlands at Wallops Flight Facility can be classified as tidal or nontidal wetlands. Wetland delineation is coordinated with the Accomack County Wetlands Board (Reference 2), the Commonwealth of Virginia, and the U.S. Army Corps of Engineers. There are three predominant wetland systems in the Wallops area: marine wetlands, estuarine wetlands, and palustrine wetlands. All marine and estuarine wetlands, and some palustrine wetlands, are considered tidal wetlands. Non-tidal wetlands can include palustrine, lacustrine, and riverine wetlands.

#### *4.1.4.3.1 Tidal Wetlands*

A tidal wetland is defined by the Code of Virginia as "all land lying between and contiguous to mean low water equal to the factor 1.5 times the mean tide range at the site" (Reference 18). Tidal wetlands include both vegetated wetlands such as swamps, marshes, and bogs, and non-vegetated wetlands such as beaches and tidal flats. Tidal wetlands have substantial economic, recreational, and wildlife habitat values, and may play a vital role in one or more of the following functions:

- Provide resting, wintering, and nesting grounds for many species of migratory waterfowl, water birds, and songbirds.
- Provide nourishment from detritus for oysters, clams, scallops, crab larvae, and newborn fish.
- Provide pollution control by treating and assimilating nutrient wastes.
- Aid in flood control and serve as a buffer to the mainland during storms.
- Contribute to the recycling of nutrients such as nitrogen and phosphorous.

Vegetated tidal wetlands in Virginia are divided into two types of marshes: the salt marshes along the Atlantic Ocean and around barrier islands, and the brackish marshes on the Chesapeake Bay. The salt marshes are typically dominated by Salt marsh Cordgrass *(Spartina alterniflora)*, and the brackish marshes are typically dominated by Black Needlerush *(Juncus roemerianus)* (Reference 3). The vegetated tidal wetlands at Wallops Flight Facility are predominantly salt marshes.

Tidal wetland vegetation can act to absorb wave energy and serves as an efficient water filter. The vegetation helps contain soil particles and prevent erosion. Vegetation production in tidal marshes equals or exceeds most agricultural crops on an acre-by-acre basis. The Virginia Institute of Marine Science has been assigned the responsibility for evaluating Virginia wetlands by type and maintaining an inventory of vegetated wetlands under the Administrative Process

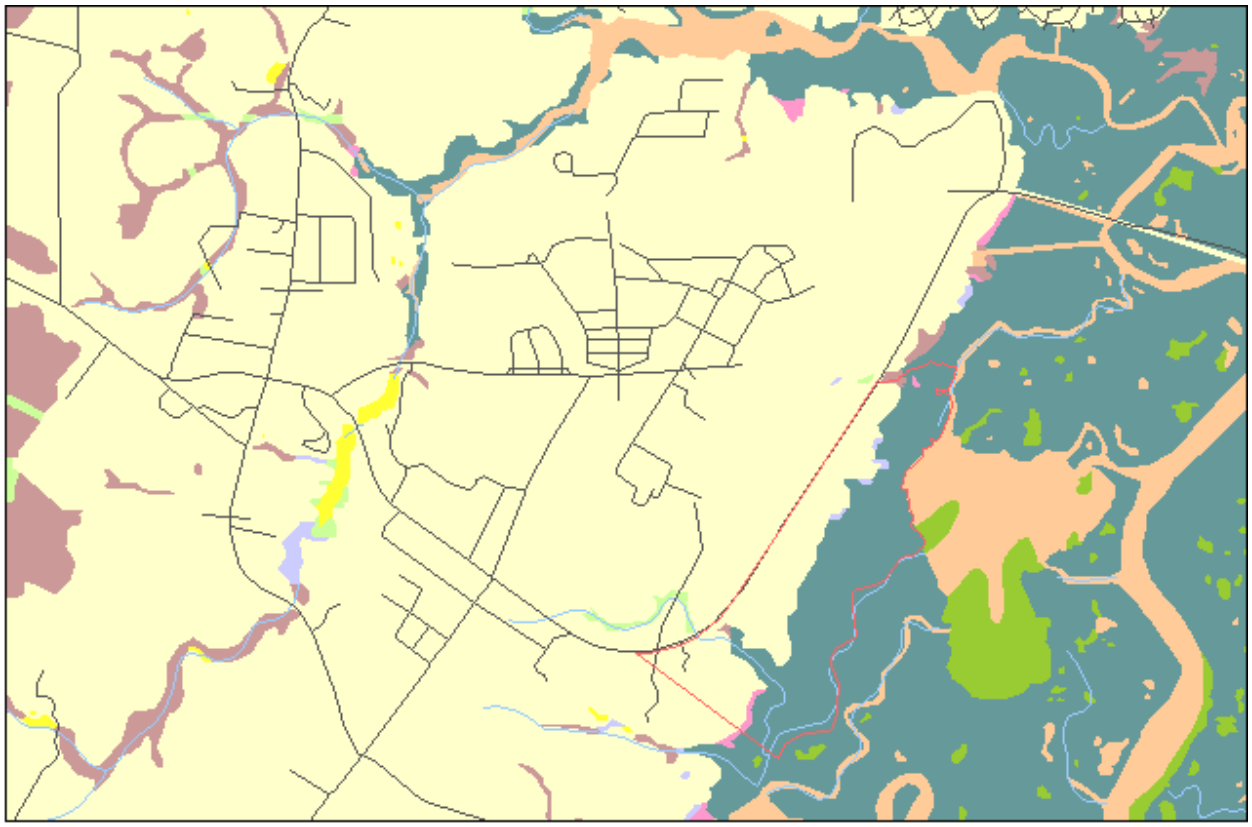


**Figure 4-10 (a)**

**National Wetland Inventory Map**
**Of Main Base**

E1UB E2AB E2EM E2RF E2SS E2US Upland
M2US PAB PEM PFO PUB PSS PUS
No Data Available

Streams
Roads
States
Counties
Open Water

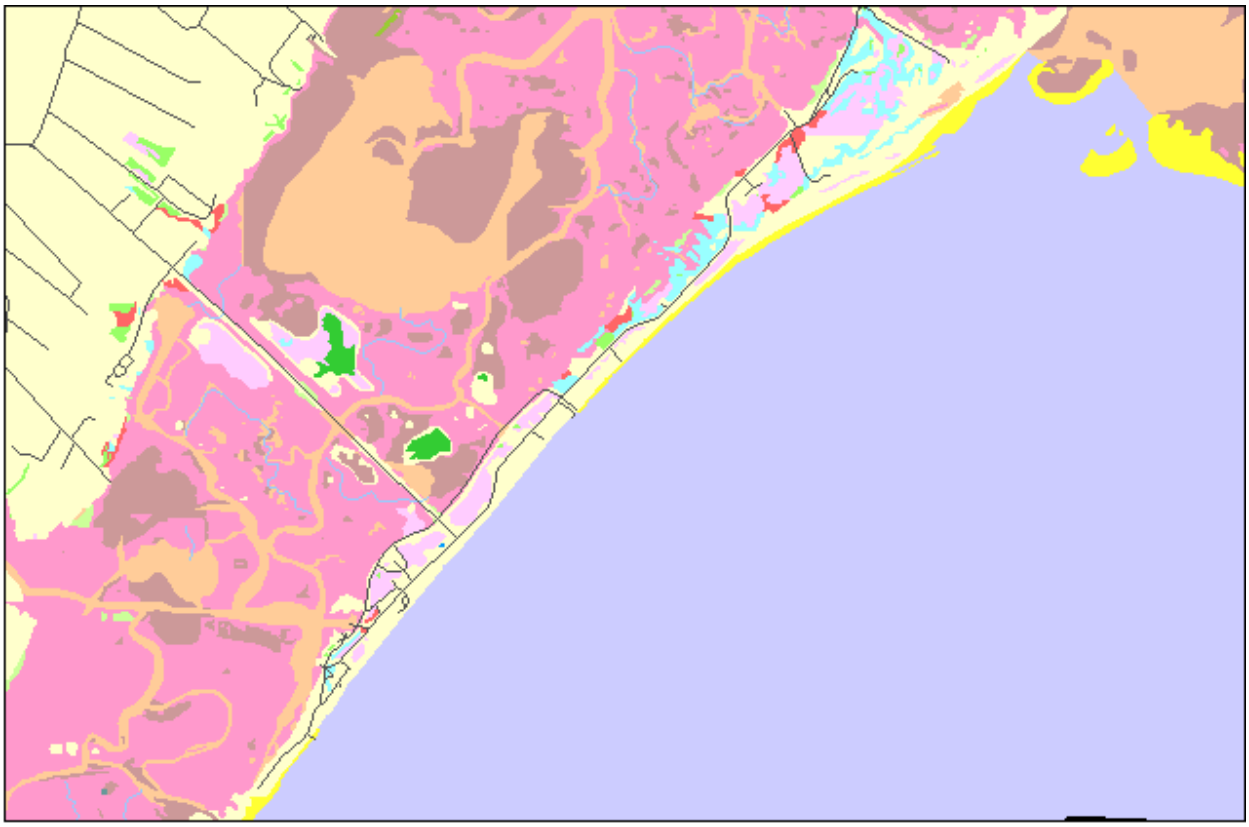


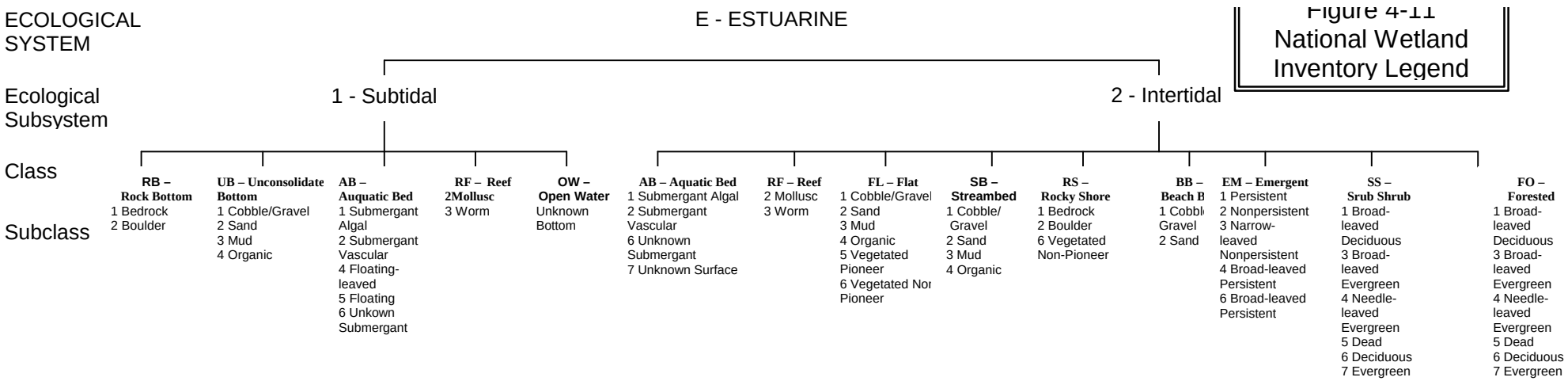
**Figure 4-10 (b)**

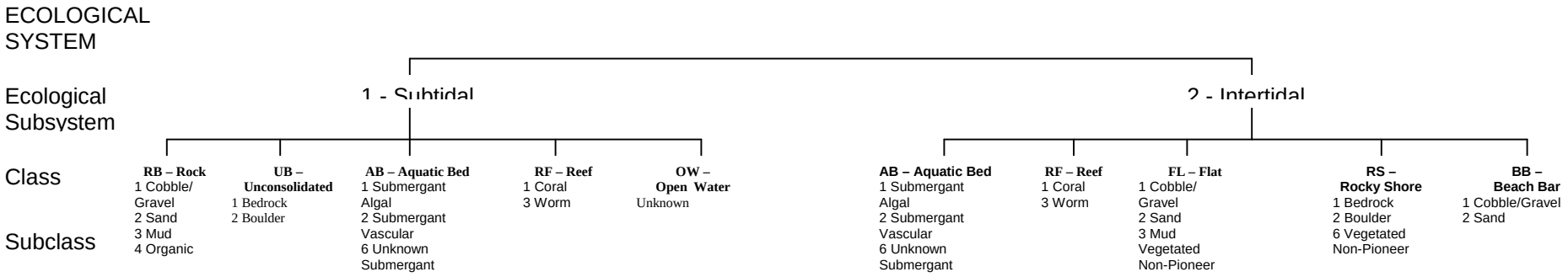
**National Wetland Inventory Map of**
**Wallops Island and Mainland**

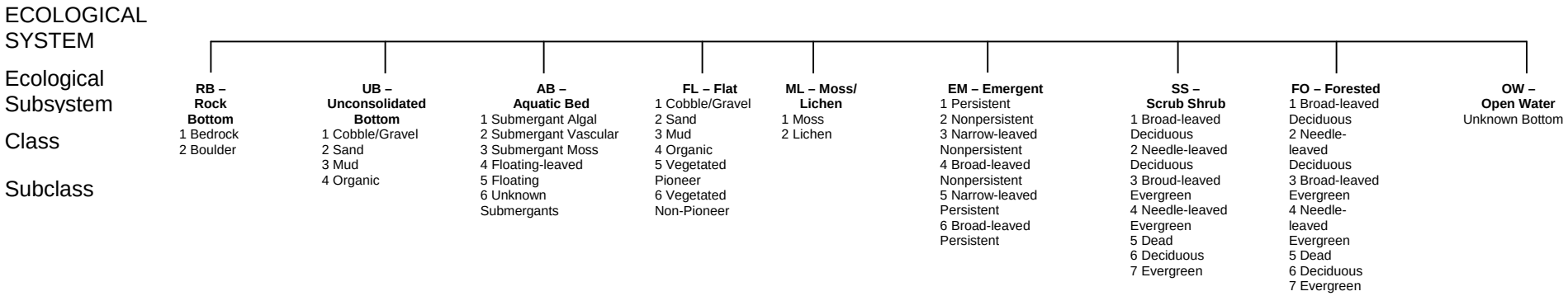
E1UB E2AB E2EM E2RF E2SS E2US Upland
M2US PAB PEM PFO PUB PSS PUS
No Data Available

Streams
Roads
States
Counties
Open Water

# Figure 4-11
# National Wetland Inventory Legend




## WATER REGIME

**Non-Tidal**

- A Temporary
- B Saturated
- C Seasonal
- D Seasonal Well Drained
- E Seasonal Saturated
- F Semipermanent
- G Intermittently Exposed
- H Permanent
- J Intermittently Flooded
- K Artificial
- Z Intermittently Exposed/Perm.
- W Intermittently Flooded/Temp
- Y Saturated/Semiperm/Seasonal
- U Unknown

**Tidal**

- K Artificially Flooded
- L Subtidal
- M Irregularly Exposed
- N Regular
- P Irregular
- R Seasonal Tidal
- S Temporary Tidal
- T Semiperm Tidal
- V Permanent Tidal
- U Unknown

## WATER CHEMISTRY

**Coastal Halinity**

- 1 Hyperhaline
- 2 Euhaline
- 3 Mixohaline (Brackish)
- 4 Polyhaline
- 5 Mesohaline
- 6 Oligohaline

**Inland Salinity**

- 7 Hypersaline
- 8 Eusaline
- 9 Mixosaline
- 0 Fresh

**pH Modifiers For All Fresh Water**

- a Acid
- t Circumnuetral
- I Alkaline

## SOIL

- g Organic
- n Mineral

## SPECIAL MODIFIERS

- b Beaver
- d Partially Drained/Ditched
- f Farmed
- h Diked/Impounded
- r Artificial Substrate
- s Spoil
- x Excavated

Act, Title 9, Chapter 1.1:1, (VAC §9-6:14:1 et. seq.). Virginia Institute of Marine Science has designated five groups of tidal wetland marshes (Table 4-9) identified by predominant vegetation type, and ranked according to the estimated per acre environmental value.

**TABLE 4-9**
**TIDAL WETLAND MARSH GROUPS AS DESIGNATED BY VIMS**

| GROUP | DESCRIPTION | TYPICAL VEGETATION |
|---|---|---|
| 1 | Highest values in productivity, waterfowl, and wildlife utility. Are associated with fish spawning and nursery areas. High values as erosion inhibitors, which is important to shellfish industry. | Salt marsh Cord grass (Spartina alterniflora)<br>Arrow Arum-Pickerel weed (Peltandra virginica)<br>Brackish water mixed marshes |
| 2 | Produces more detritus than Group 1 marshes because they typically grow at higher elevations where less tidal action can flush detritus into waterways. High values in protecting water quality and can act as buffers against coastal flooding. | Big Cord grass (Spartina cynosuroides)<br>Salt Meadow Cord grass (Spartina patens)<br>Cattail marshes (Typha spp.) |
| 3 | High value to wildlife and waterfowl. Ranks high as an erosion and flood buffer. | Yellow Pond Lily (Nophar luteum)<br>Black Needle rush (Juncus roemerianus) |
| 4 | Adds diversity and bird nesting areas to the marsh ecosystem. Can act somewhat as an erosion buffer. | Salt bush marsh (Atriplex spp.) |
| 5 | Very few values as a habitat, detritus producer, or erosion control agent. | Salt wort (Batis maritima)<br>Reed grass (Calamagrostis spp.) |

(Reference 3)

#### *4.1.4.3.2 Non-tidal Wetlands*

A non-tidal wetland is defined as an area that is inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support (and under normal circumstances does support) a prevalence of vegetation typically adapted for life in saturated soil conditions. This vegetation is commonly known as hydrophytic vegetation and is classified as such according to the United States Fish and Wildlife Service (USFWS) *Federal Manual for Identifying and Delineating Jurisdictional Wetlands* (Reference 93).

Non-tidal wetlands may play a vital role in one or more of the following functions:

- Reduction of pollutant loading, including excess nutrients, sediments, and toxins.
- Attenuation of floodwater and stormwater.
- Erosion control.
- Breeding grounds and habitat for plant and wildlife species including threatened and endangered species and those in need of conservation.
- Food chain support.

Non-tidal wetlands can be classified under the U.S. Department of the Interior classification system which includes the palustrine, lacustrine, or riverine wetlands systems (Reference 85). The National Wetlands Inventory maps indicate that the predominant type of non-tidal wetlands at Wallop Flight Faciliy are in the Palustrine System (Figures 4-10(a) and 4-10(b). The key to the wetland symbols is shown on Figure 4-11. Wetlands within each system are classified according to their vegetation. The vegetation types that occur at or near Wallops Flight Facility include forested wetlands, scrub-shrub wetlands, emergent wetlands, aquatic bed wetlands, and open water wetlands (Table 4-10).

**TABLE 4-10**
**PREDOMINANT WETLAND TYPES IN THE VICINITY OF WALLOPS FLIGHT FACILITY**

| TYPE | DESCRIPTION | TYPICAL VEGETATION |
|---|---|---|
| Forested Wetlands | These wetlands typically include swamps dominated by trees over 20 feet in height and include many floodplain areas. They normally possess an overstory of trees, an understory of young trees or shrubs, and a herbaceous layer. They provide habitat and help prevent nutrients and sediments from entering the water when situated along streams. | Red Maple (Acer rubrum)<br>Sweet gum (Liquidambar styraciflua)<br>River birch (Betula nigra)<br>Ashes (Fraxinus spp.) |
| Scrub Shrub Wetlands | These wetlands include tree shrub swamps or wetlands dominated by small trees less than 20 feet in height. True shrub wetlands are relatively uncommon and many scrub-shrub wetlands become forested over time. These wetlands provide cover and browse for wildlife. | Alder (Alnus spp)<br>Buttonwood (Conocarpus erectus)<br>Dogwood (Cornus florida)<br>Sweetbay Magnolia (Magnolia virginiana)<br>Spicebush (Lindera benzoin) |
| Emergent Wetlands | These wetlands are known as marshes characterized by erect, rooted, herbaceous hydrophytes excluding mosses and lichens. Vegetation is present for most of the growing season in most years. | Cattails (Typha spp.)<br>Sedges (Carex spp.)<br>Rushes (Juncus spp.) |
| Aquatic Bed Wetlands | These wetlands are dominated by plants that grow principally on or below the surface of water for most of the growing season. These wetlands represent a diverse group of plant communities that require surface water for optimum growth and reproduction. The plant species are best developed in relatively permanent water or under conditions of repeated flooding. The plants are either attached to the substrate or float freely in the water above the bottom or on the surface. Waterfowl often use these wetlands, wetlands provide water during drought conditions. | Spatter dock (Nuphar luteum)<br>Pickerel weed (Pondedenia cordata) |
| Open Water Wetlands | These wetlands are permanently flooded areas typically characterized as lakes or ponds. | |

(Reference 85)

#### 4.1.4.4 Barrier Island Resource Area

Wallops Flight Facility lies within the coastal zone and subsequently is subject to regulations that protect the shoreline. The coastal zone is defined as the tidal area. The Main Base, Mainland, and Wallops Island are all within the coastal zone. Wallops Island contains coastal primary sand dunes that serve as protective barriers from the effects of flooding and erosion caused by coastal storms. The Virginia Coastal Primary Sand Dune Act (Section 6 2.1-13.23) protects the dunes unique physiographic features and their natural functions. For projects that may impact a coastal primary sand dune, Wallops Flight Facility consults with the Virginia Marine Resources Commission (VMRC), which establishes standards for protection of the sand dunes. The Virginia Marine Resources Commission determines the need for permits in accordance with the Virginia Coastal Primary Sand Dune Act. A permit for a seawall rehabilitation project on Wallops Island was issued by the Virginia Marine Resources Commission .

Wallops Island is one of a limited number of barrier islands along the Atlantic Coast. Barrier islands are elongated narrow landforms, which consist largely of unconsolidated and shifting sand, and lie parallel to the shoreline between the open ocean and the mainland. Barrier islands can serve many purposes including providing protection to the mainland, providing unique recreation resources, providing important natural habitats to unique species, and providing valuable economic opportunities to the country. Barrier islands are often considered wetland resources since they support a variety of wetland types and typically lie within the coastal 100 -year floodplain. Because of the uniqueness of barrier islands, the Commonwealth of Virginia and the United States Fish and Wildlife Service have developed policies to regulate activities on barrier islands and to protect coastal primary sand dunes on barrier islands (References 21, 95). Proposed activities that may affect coastal primary sand dunes on Wallops Island are coordinated and approved with the Commonwealth of Virginia.

#### 4.1.4.5 Floodplain Resources

A floodplain study was performed to delineate more accurately the floodplains for the 100 -year storm for Wallops. This study used the Wave Height Analysis for the Flood Insurance Study model that calculates wave heights, wave crest elevations, flood hazard zone designations, and the location of flood zone boundaries along a perpendicular transect (Reference 32). Six additional transects were developed. Between transects previously developed by the Federal Emergency Management Agency (FEMA) to delineate the floodplains at Wallops Flight Facility (Reference 32). The information from this study is presented as baseline information to be evaluated for future construction or proposed projects at Wallops Flight Facility. The items considered in the development and interpretation of the model are topography, local weather patterns, changes in sea level, existing floodplain measures, other models (document review), and the actual transect development. A description of topography at Wallops Flight Facility can be found in Section 4.1.1.2, Topography and Drainage. A description of local weather patterns can be found in Section 4.1.5.1.1, Regional Weather Patterns. Anticipated changes in sea level, existing floodplain measures, a document review of previous modeling studies, a description of the transects used, and the model results are discussed below.

#### *4.1.4.5.1 Changes in Sea Level*

Mean sea level slowly changes in many locations due to the combined effects of local land subsidence (or uplift) and fluctuations in global temperatures. The latter may cause increased melting of the ice caps and thermal expansion of seawater, which both result in sea level rise. The local rate of land subsidence in the project area is on the order of 0.122 inches (3.1 millimeters) per year (Reference 76). The rate of sea level rise due to global warming cannot be accurately predicted.

The following formula has been proposed for global (or eustatic) sea level rise, accounting for different scenarios (Reference 76).

$E(t) = 1.2t + bt^2$

where: $E(t)$ = global sea level rise after 1987 in mm
$t$ = time in years
$b$ = coefficient from 0.001 to 0.004 in/yr$^2$ (0.028 to 0.105 mm/yr$^2$) for different scenarios

Thus, for the project area, a sea level rise of 6.8 inches (172 mm) to 10.1 inches (256 mm) can be expected between 1987 and 2020. Given the local topography, the implications of these global sea level rise estimates on flooding are that the 100-year stillwater elevation, and thus the 100-year wave crest elevation, are likely to increase in the future.

#### *4.1.4.5.2 Existing Floodplain Protection Measures*

In 1958, Wallops constructed timber bulkheads parallel to the beach and wooden groins perpendicular to the beach. NASA removed most of the groins in the middle 1990's. The bulkheads have deteriorated. NASA has constructed a seawall along much of the beach from large pieces of granite. The sections of granite range in size from 500 to 6,000 pounds (227 to 2,722 kilograms).

The transects developed in this study were not placed across the reconstructed seawall. Therefore, the Wave Height Analysis for Flood Insurance Study model did not account for the seawall flood protection. This study represents the worst case scenario for the 100-year flood.

#### *4.1.4.5.3 Document Review*

Two previous studies of the Wallops Island floodplains were prepared in response to the construction of shore protection measures. The Wallops Island Shore Protection Study (M&N, 1986) provided preliminary recommendations for construction of a seawall that would retain a 20-year or less storm. The design was based on water elevations from gauges that did not include hurricanes, which are typically the most damaging storms to affect this area. The report states that the life of the proposed seawall is limited, and its ability to prevent flooding and beach damage would not completely hold back the storm; however, it should be effective for storms with a recurrence interval of 20 years or less.

The Wallops Island Shoreline Evolution Modeling study used the Genesis model to predict erosion rates of the shoreline. The Genesis model "simulates (long-term) shoreline change produced by spatial and temporal differences in longshore transport" (Reference 67). This study

predicts accelerated erosion rates in the unprotected areas on Wallops Island following the reconstruction of the seawall. It predicts significant erosion about 1400 feet (427 meters) south of the seawall terminus and minor erosion 4,300 feet (1,310 meters) south of the seawall terminus. If this increase in erosion occurs, it is likely to increase the Wallops Island floodplain area. An assessment of the actual erosion rates versus predicted erosion rates after an extended period determines the degree of precision of the Genesis model.

The Genesis model had several limitations that include the following:

- The inability to simulate the rapid changes in the shoreline position which could occur from a severe storm, such as the January 1992 northeaster (Reference 67).
- The inability to differentiate between rubble (rip-rap) and sheet pile. The model simulates a sheet pile seawall where NASA's seawall is actually a rip-rap seawall. This difference affects the predicted erosion rates (Reference 67).

#### *4.1.4.5.4 Transect Development*

The six transects developed for the Wave Height Analysis for Flood Insurance Study model, were evenly spaced between FEMA transects to ensure that all areas of Wallops Flight Facility were represented. Figure 4-12 identifies the approximate locations of the six transects (A-E and M&E 8) developed for this study and the previously developed FEMA transects. Transect eight was developed in the FEMA study and also reanalyzed in this study using the updated Wave Height Analysis for Flood Insurance Study Version 3 (WHAFIS3) model.

#### *4.1.4.5.5 Model Results*

Damage from tidal floods depends on many factors. The topography of the flooded area, the rate of rise of floodwater, depth and duration of flooding, exposure to wave action, and the extent of development in the floodplain all play a role in determining the amount and extent of damage. The duration of tide-producing forces determines the duration of the flood.

During a tidal flood, both the 100-year stillwater elevation and the wave crest generated determine the final flood elevation. During the 100-year storm, the wave crest would almost inundate Wallops Island. The 100-year floodplain based on the wave crest elevation of approximately 14 feet (4.3 meters), mean sea level, is shown on Figures 4-13(a) and 4-13(b). These conclusions were based on the output from the Wave Height Analysis for Flood Insurance Study model. The 500-year floodplain elevation from the FEMA Flood Insurance Study is 10.9 feet (3.3 meters), mean sea level.

The stillwater elevations, wave crest profile, and the zone designations for each transect were plotted from the Wave Height Analysis for Flood Insurance Study output. Erosion assessments were performed for all transects with dune areas.

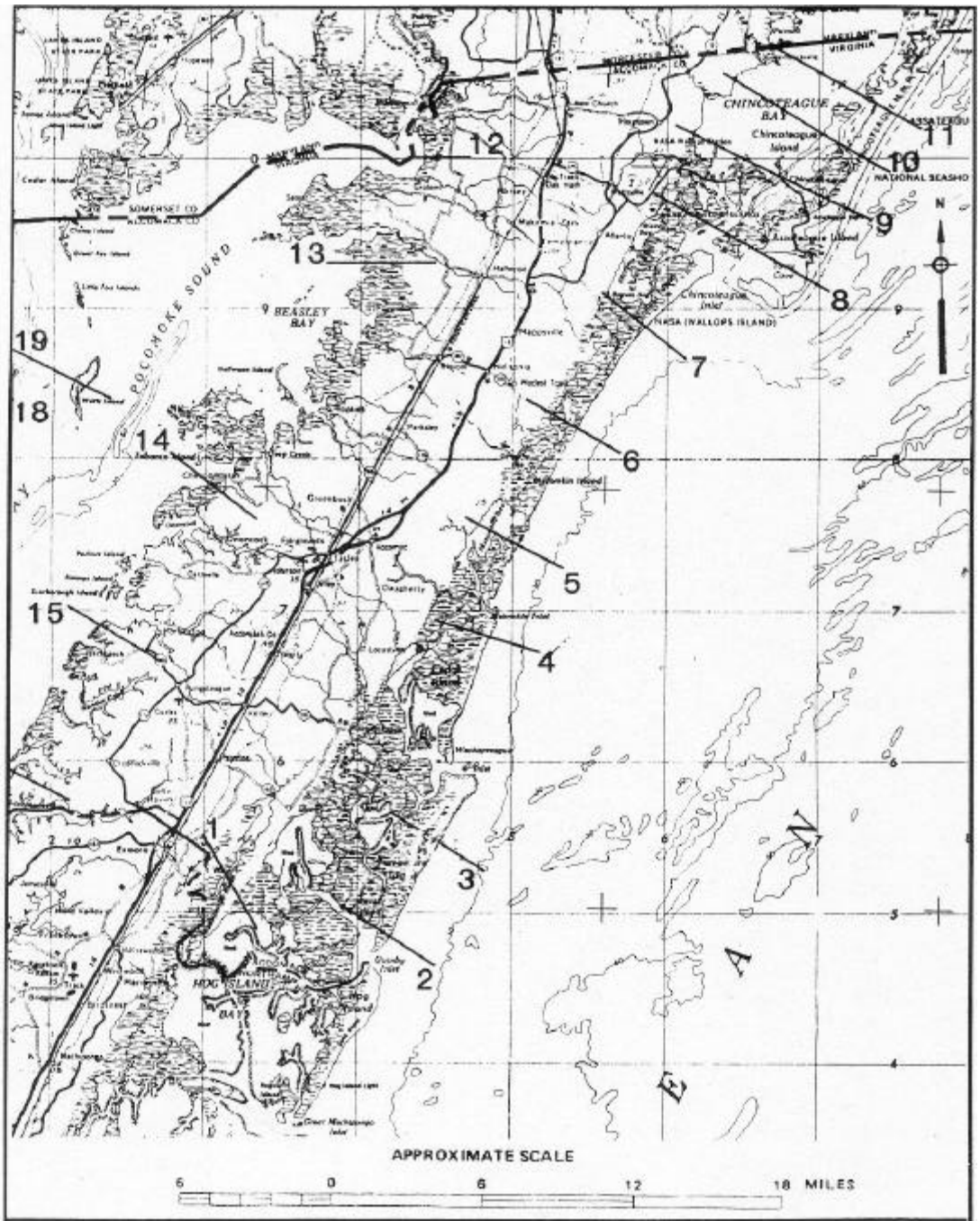



FIGURE 4-12
APPROXIMATE LOCATIONS OF DEVELOPED TRANSECTS
USED FOR WALLOPS FLIGHT FACILITY FLOOD PLAIN STUDY

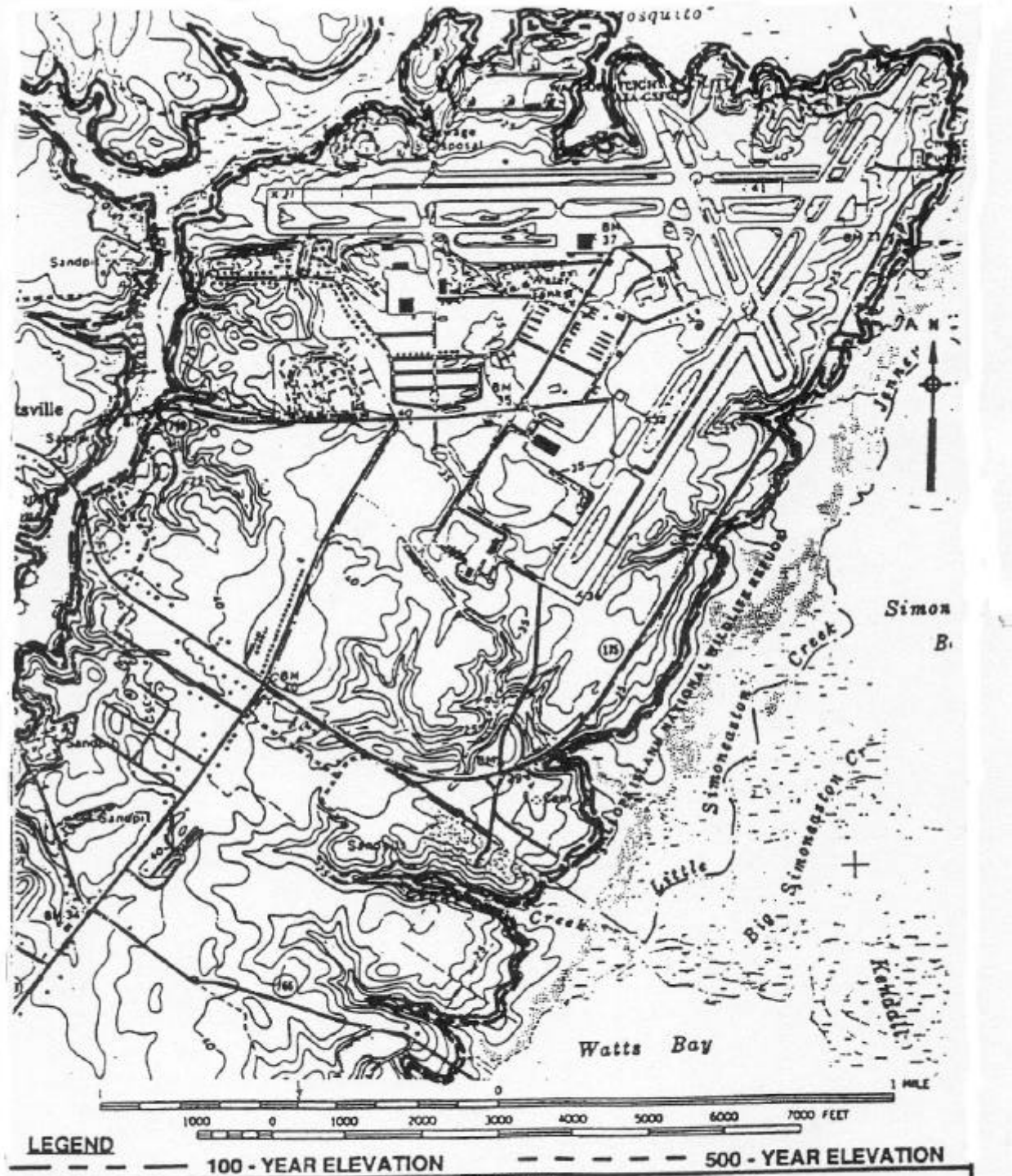



FIGURE 4-13 (a)
100 - YEAR WAVE CREST ELEVATION (14 FEET, MSL)
500 - YEAR STILLWATER ELEVATION (10.9 FEET, MSL)
FOR NASA WALLOPS FLIGHT FACILITY MAIN BASE

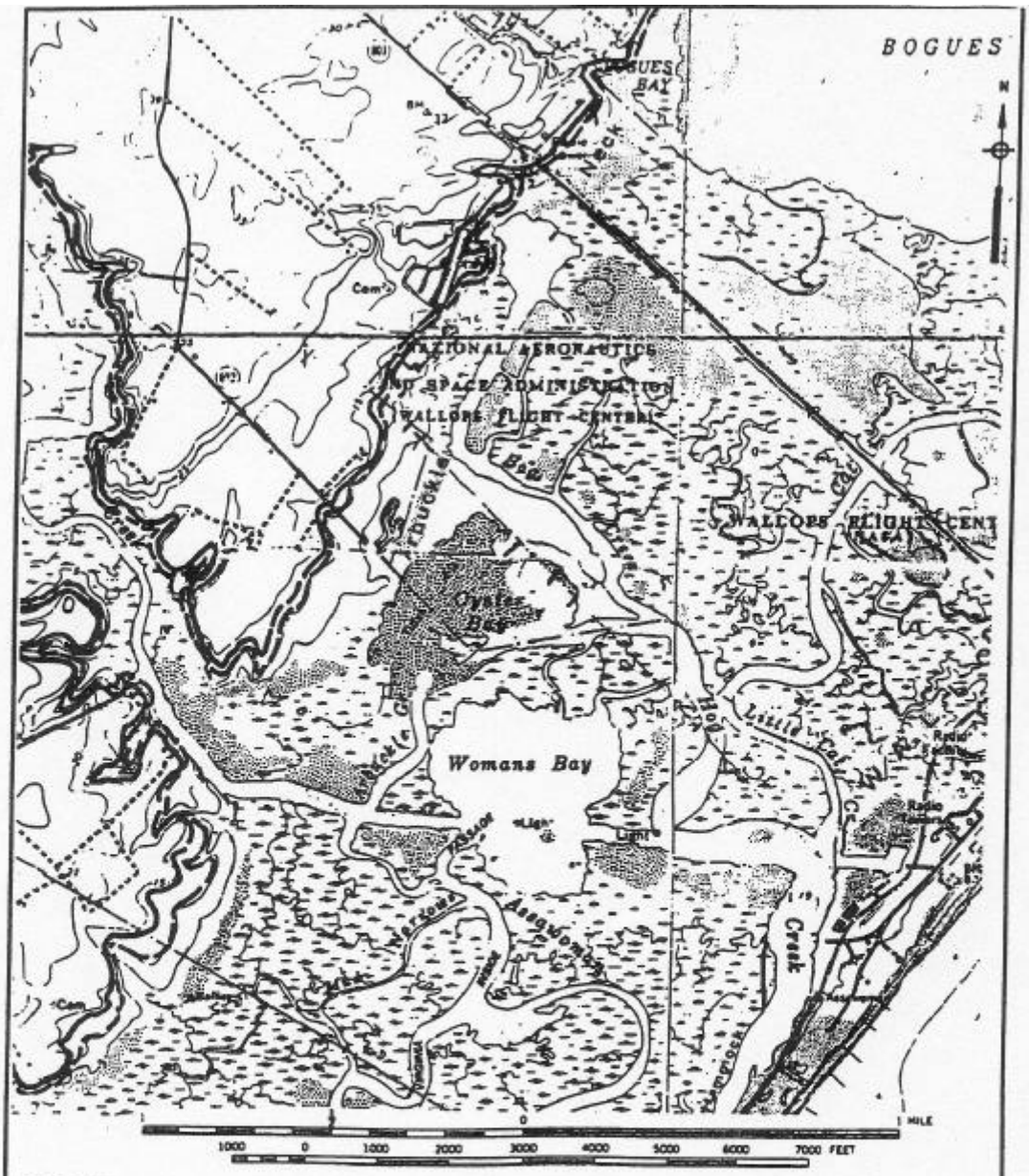



FIGURE 4-13 (b)
100 - YEAR WAVE CREST ELEVATION (14 FEET, MSL)
500 - YEAR STILLWATER ELEVATION (10.9 FEET, MSL)
FOR SOUTHERN PORTION OF WALLOPS ISLAND AND MAINLAND

## 4.1.5 Air Quality

### 4.1.5.1 Climatic Conditions

#### *4.1.5.1.1 Regional Weather Patterns*

Wallops Flight Facility is located in the climatic region known as the humid continental warm summer climate zone. Large temperature variations during the course of a single year and lesser variations in average monthly temperatures typify the region. The climate is tempered by the proximity of the Atlantic Ocean to the east and the Chesapeake Bay to the west. Also affecting the climate is an air current, know as the Labrador Current, which originates in the polar latitudes and moves southward along the Delmarva coastline. The current creates a wedge between the warm Gulf Stream off shore and the Atlantic coast. (Reference 53).

The climate of the region is dominated in winter by polar continental air masses and in summer by tropical maritime air masses. Clashes between these two air masses create frontal systems, resulting in thunderstorms, high winds, and precipitation (Reference 53).

Temperature and precipitation in this climate zone vary seasonally. Four distinct seasons each demonstrate characteristic temperatures. In winter, sustained snowfall events are rare. Spring is wet with increasing temperatures. Summer is hot and humid with precipitation occurring primarily from thunderstorm activity. Autumn is characterized by slightly decreasing temperatures and strong frontal systems with rain and sustained winds (Reference 53).

#### *4.1.5.1.2 Local Climatological Data*

Climatological records are maintained by the Wallops Flight Facility Meteorological Office. A summary of local climatological data is presented in Table 4-11. Complete annual summaries are included in Appendix A.

**TABLE 4-11**
**LOCAL CLIMATOLOGICAL DATA**

| | | |
|---|---|---|
| Temperatures (°F) | | |
| Normal Daily Maximum | Year | 66.5° |
| | Highest, Month | 85°, July 1998 |
| Normal Daily Minimum | Year | 49° |
| | Lowest, Month | 31.7°, February 1999 |
| Annual Daily Average | | 57.7 |
| Extreme High | | 98°, August 1998 |
| Extreme Low | | 13°, January 1999 |
| Wind: | | |
| Prevailing Direction: South | | |
| Months of greatest mean wind speed: February and March | | |
| Months of lowest mean wind speed: July and August | | |
| Precipitation (inches): | | |
| Normal yearly: | | 39.0 |
| Maximum monthly: | | 6.87, March 1999 |
| Minimum monthly | | 0.82, July 1998 |

(Reference 111) (June '98 through May '99)

#### *4.1.5.1.3 Severe Weather*

Severe weather such as hurricanes, northeasters, and thunderstorms can result in high winds, heavy rainfalls, and reduced visibility. All of these factors can result in significant impacts to operations at the Wallops Flight Facility, particularly those related to the airport and sounding rockets program. Hurricanes are the most severe type of storm in this area, with high winds, and heavy rainfall. A hurricane is an intense cyclonic storm originating in tropical or subtropical latitudes in the Atlantic Ocean just north of the equator. Hurricanes are known to affect this area from May through November, but most occur from August through October. Hurricanes, or remnants of hurricanes, which have affected the Wallops Flight Facility area within the last 50 years include Hurricane Hazel (October 1954), Hurricane Connie (August 1955), Hurricane Donna (September 1960), Hurricane Agnes (June 1972), and Hurricane Gloria (September 1985) (Reference 32).

Northeasters are also cyclonic-type storms, but normally develop near the Atlantic coast, intensify, and produce high winds, waves, tides, and rainfall along the coast. This type of storm occurs most frequently in the winter, but can occur at any time and develop very rapidly, sometimes in a matter of hours. Major northeasters can do as much damage or more than some hurricanes. Major northeasters affected the Wallops Flight Facility area in November 1950, March 1962, October and November 1991, and January 1992 (Reference 32). Thunderstorms are a common occurrence during the summer months, often providing the only source of precipitation during the season. During June, July, and August, thunderstorms occur on an average of four to seven days per month. Most of the thunderstorms occur during late afternoon and evening and are accompanied by wind gusts up to 40 to 50 knots (74.1 to 92.6 kph) (Reference 53).

### 4.1.5.2 Air Quality Standards

The Ambient Air Quality Standards published by the Commonwealth of Virginia are equal to, or more stringent than, National Ambient Air Quality Standards. The Commonwealth promulgates air quality standards through the State Air Pollution Control Board.

The Wallops Flight Facility is located in Air Quality Control Region 4 and Administrative Region 6. The Wallops Flight Facility is located in an attainment area for the Ambient Air Quality Standards. The Standards are contained in 9 VAC 5-30 of the Virginia Administrative Code Regulations for the Control and Abatement of Air Pollution. Primary standards for protection of human health, and secondary standards for protection of public welfare, are included in Section 9 VAC 5-30 for criteria pollutants. The Standards are summarized in Table 4-12.

### 4.1.5.3 Ambient Air Quality

The Virginia Department of Air Pollution Control does not currently perform ambient air quality monitoring in the vicinity of the Wallops Flight Facility. The Virginia Department of Air Pollution Control considers the Eastern Shore of Virginia to be an attainment area for ozone, indicating compliance with primary and secondary standards. Accomack County is not designated as an Air Quality Maintenance Area in the Regulations for the Control and

Abatement of Air Pollution (Reference 26). An Air Quality Maintenance Area is defined as "any area which, due to current air quality or projected growth rate or both, may have the po tential for exceeding any ambient air quality standard (for criteria pollutants) within a subsequent 10 -year period."

**TABLE 4-12**
**COMMONWEALTH OF VIRGINIA AMBIENT AIR QUALITY STANDARDS**

| PARAMETER (CRITERIA POLLUTANT) | PRIMARY | | SECONDARY | |
|---|---|---|---|---|
| | ($\mu/m^3$) | (ppm) | ($\mu/m^3$) | (ppm) |
| Sulfur Oxides (sulfur dioxide) | | | | |
| Annual arithmetic mean | 80 | 0.03 | - | - |
| Maximum 24-hour concentration* | 365 | 0.14 | - | - |
| Maximum 3-hour concentration* | - | - | 1300 | 0.50 |
| Carbon Monoxide | | | | |
| Average 8-hour concentration* | 10,000 | 9 | 10,000 | 9 |
| Average 1-hour concentration* | 40,000 | 35 | 40,000 | 35 |
| Ozone | | | | |
| Maximum 1-hour concentration | 235 | 0.12 | 235 | 0.12 |
| Particulate Matter ($PM_{10}$) | | | | |
| 24-hour average concentration | 150 | - | 150 | - |
| Annual arithmetic mean | 50 | - | 50 | - |
| Nitrogen Dioxide | | | | |
| Annual arithmetic mean | 100 | 0.053 | 100 | 0.053 |
| Lead | | | | |
| Maximum arithmetic mean (averaged over calendar year) | 1.5 | - | 1.5 | - |

* - Not to be exceeded more than once per year
ppm - Parts per million
($\mu/m^3$) - Micrograms per cubic meter

(Reference 26)

### 4.1.5.4 Potential Emissions Sources

Significant potential emission sources at Wallops Flight Facility include:

- Rocket Launches
- Airport Activities
- Open Burn Area
- Central Boiler Plant, Building D-8
- Plating, Building F-8
- Paint Spray Booth, Building F-16
- Industrial Shops, Buildings F-10 and F-16

- Paint Shop, Building X-30 Wallops Island
- Paint Shop, NOAA Maintenance Facility

Less significant potential emissions sources include gasoline storage tanks, stand-by generators, boilers for individual buildings, laboratory hoods, process vents, construction-related activities, and vehicular traffic.

#### *4.1.5.4.1 Rocket Launches*

Rocket launches generate emissions through the combustion of fuel and self-contained oxidizers. Combustion products emitted are predominantly aluminum oxide, carbon monoxide, hydrogen chloride, water, nitrogen, carbon dioxide, and hydrogen. Approximate percentages of emissions components from Nike and Malemute rocket motors are summarized in Table 4-13. The motor type is hydroxyl-terminated polybutadiene (HTPB) with aluminum (Reference 53). Mole fractions of the various combustion products of MAF-1 with IRFNA are summarized in Table 4-14. The mole fraction is independent of the amount of propellant. When these compounds are used as plume generators, the release of these liquids is high in the atmosphere.

Of the predominant combustion products, carbon monoxide is the only one regulated by the EPA and the Commonwealth of Virginia under the State adopted National Ambient Air Quality Standards (Table 4-13). Aluminum oxide, chlorine, hydrochloric acid, and lead are rocket launch combustion products that have been identified as Priority Chemicals by the Commonwealth of Virginia. Exposure guidelines used by the Commonwealth of Virginia are derived from the American Conference of Governmental Industrial Hygienists Threshold Limit Values (TLVs). The values are presented in Table 4-15 as Time-Weighted Averages (TWA), ceilings, and short-term exposure limits (STEL). The Time-Weighted Average is the average concentration for a normal 8-hour workday to which nearly all workers may be repeatedly exposed, without adverse effects. The ceiling is the concentration that should not be exceeded during any part of the working exposure. The short term exposure limit is the concentration to which workers can be exposed continuously for a short period of time without suffering from irritation, chronic or irreversible tissue damage, or narcosis severe enough to increase the possibility of accidental injury, impair self-rescue, or reduce work efficiency. The Commonwealth of Virginia uses these values to determine exempt emission rates for toxic pollutants emitted by a stationary source or an operation that is not part of stationary source (Reference 26).

**TABLE 4-13**
**ROCKET MOTOR (HTPB) EMISSIONS COMPONENTS**

| COMPOUND | PERCENT BY WEIGHT |
|---|---|
| Aluminum Oxide | 36.0 |
| Carbon Monoxide | 21.0 |
| Hydrogen Chloride | 21.0 |
| Water | 8.5 |
| Nitrogen | 8.5 |
| Carbon Dioxide | 2.5 |
| Hydrogen | 2.0 |
| Other | 0.5 |
| | 100.0 |

(Reference 53)

**TABLE 4-14**
**MOLE FRACTIONS OF THE VARIOUS COMBUSTION PRODUCTS OF MAF-1 WITH IRFNA****

| COMPOUNDS | MOLE FRACTION |
|---|---|
| CO | 0.05289 |
| $CO_2$ | 0.17257 |
| F | 0.0000 |
| H | 0.00024 |
| HF | 0.00660 |
| HNO | 0.00000 |
| $HO_2$ | 0.00000 |
| $H_2$ | 0.3375 |
| $H_2O$ | 0.48877 |
| $H_2O_2$ | 0.0000 |
| NO | 0.0003 |
| $NO_2$ | 0.00000 |
| $N_2$ | 0.24480 |
| O | 0.00000 |
| OH | 0.00033 |
| $O_2$ | 0.00001 |
| Total Moles | 0.0409 |
| Moles of Gas | 0.0409 |

**Red Fuming Nitric Acid
Note: Theoretical rocket performance assuming equilibrium composition during expansion.

The emitted combustion products are distributed along the rocket trajectory under normal launch conditions. The quantities emitted per unit length of the trajectory are greatest at ground level and decrease continuously. Some launch vehicles are equipped with destruct systems that rupture the propellant tanks and release all remaining propellants in the event of an in-flight vehicle failure (Reference 42).

**TABLE 4-15**
**AIR QUALITY GUIDELINES FOR EXPOSURE TO ROCKET EXHAUST**

| COMBUSTION PRODUCT | CAS NO. | TWA MG/M³ | CEILING MG/M³ | STEL MG/M³ |
|---|---|---|---|---|
| Aluminum oxide (as Aluminum) | 1344-28-1 | 10 | - | - |
| Chlorine | 7782-50-5 | 1.5 | - | 2.9 |
| Hydrochloric acid | 7647-01-0 | - | 7.5 | - |
| Lead, inorganic Dusts and fumes (as Pb) | 7439-92-1 | 0.15 | - | - |

Abbreviations: CAS No. = Chemical Abstract System Number
TWA = Time-Weighted Average
CL = Ceiling Limits
STEL = Short-Term Exposure Limits
$Mg/m^3$ = Milligrams per cubic meter

(Reference 8)

Table 4-16 presents the dispersion characteristics of selected atmospheric layers. Table 4-17 lists the combustion products, emitted into each layer. Emissions from the larger Atlas/Centaur and TIIIE/Centaur rockets are substantially more than the rockets currently launched from Wallops Flight Facility. The Atlas/Centaur and TIIIE/Centaur data is presented for comparison purposes.

**TABLE 4-16**
**DISPERSION CHARACTERISTICS WITHIN SELECTED ATMOSPHERIC LAYERS**

| ATMOSPHERIC LAYER ALTITUDE RANGE | TEMPERATURE STRUCTURE | WIND STRUCTURE | CHARACTERISTIC MIXING RATE |
|---|---|---|---|
| Below nocturnal inversion 0-500 m | Increase with height | Very light or calm | Very poor |
| Below subsidence inversion 0-1500 m | Decrease with height to inversion base | Variable | Generally fair to inversion base |
| Troposphere 0.5-20 km | Decrease with height | Variable; increase with height | Generally very good |
| Stratosphere 20-67 km | Isothermal or increase with height | Tends to vary seasonally | Poor to fair |
| Mesosphere-Thermosphere Above 67 km | Decrease with height | Varies seasonally | Good |

Ground level concentrations of potential emission pollutants were estimated by NASA using the NSA/MSFC multilayer atmospheric diffusion model. The exhaust cloud was assumed to rise buoyantly. The model results are presented in Appendix M for three meteorological conditions. The exposure criteria indicated are the Threshold Limit Values (TLVs) for controlled populations (considered conservative for short duration infrequent exposures) and the criteria for exposure of uncontrolled populations to ordinary operations. The distance scales represent the maximum distances at which the graphed concentrations could be found (Reference 42).

**TABLE 4-17**
**QUANTITIES OF POTENTIAL POLLUTANTS**
**EMITTED INTO SELECTED ATMOSPHERIC LAYERS**

| VEHICLE | ATMOSPHERIC LAYER Altitude Range | | | | |
|---|---|---|---|---|---|
| | NOCTURNAL INVERSION 0-500 M (Emissions/kg) | SUBSIDENCE INVERSION 0-1500 M (Emissions/kg) | TROPOSPHERE 0.5-20 KM (Emissions/kg) | STRATOSPHERE 20-67 KM (Emissions/kg) | MESOSPHERE-THERMOSPHERE Above 67 km (Emissions/kg) |
| Scout | | | | | |
| HCL | 60 | 180 | 2290 | 760 | 450 |
| CO | 110 | 310 | 4000 | 970 | 830 |
| NO* | .07 | 0.5 | 6.4 | 2.3 | 1.4 |
| $CO_2$ | | | | 100 | 64 |
| Delta (3C) | | | | | |
| HCL | 690 | 1130 | 1710 | 0 | 0 |
| CO | 2600 | 4120 | 10780 | 14,400 | 3360 |
| NO* | 1.8 | 3.2 | 4.5 | 0 | 70 |
| $CO_2$ | | | | 10,700 | 3970 |
| Delta (6C) | | | | | |
| HCL | 830 | 1840 | 3920 | 0 | 0 |
| CO | 2500 | 4260 | 11320 | 14900 | 4930 |
| NO* | 2.3 | 5.0 | 11 | 0 | 70 |
| $CO_2$ | | | | 11000 | 4540 |
| Delta (9C) | | | | | |
| HCL | 1100 | 1750 | 5630 | 410 | 0 |
| CO | 3020 | 4550 | 13740 | 13350 | 5830 |
| NO* | 3.2 | 4.5 | 15 | 0.9 | 70 |
| $CO_2$ | | | | 9600 | 4540 |
| Atlas/ | | | | | |
| Centaur | 0 | 0 | 0 | 0 | 0 |
| HCL | | 1003 | 24310 | 17500 | 4540 |
| CO | 6310 | 0 | 0 | 0 | 0 |
| NO* | | | | 13100 | 3300 |
| $CO_2$ | | | | | |
| TIIIE/ | | | | | |
| Centaur** | 9800 | 14920 | 47170 | 24040 | 0 |
| HCL | 17510 | 26540 | 83000 | 43320 | 3060 |
| CO | 30 | 41 | 126 | 750 | 1520 |
| NO* | | | | 10700 | 20400 |
| $CO_2$ | | | | | |

* The NO formed from $H_2$ impurity in the stages using liquid oxygen (Atlas, Thor, Centaur) is not included. The concentration of NO in the exhaust of such stages has been estimated at 3 ppm for an $N_2$ impurity level of 600 ppm. The resulting NO emissions are negligible.

** The Titan IIIC is equivilant to the TIIIE/Centaur except for changes in the emissions above 67 km. These changes are not significant in terms of upper atmospheric effects.

(Reference 91)

Table 4-18 lists the average exhaust emission compounds of composite and double-base propellant rocket motors launched from Wallops Flight Facility.

**TABLE 4-18**
**AVERAGE EXHAUST EMISSIONS (kg) FROM ROCKET MOTORS**

| | COMPOSITE ROCKET MOTOR | |
|---|---|---|
| COMPOUND | MINIMUM REQUIREMENTS | MAXIMUM REQUIREMENTS |
| Aluminum chloride | 0 | N/A |
| Aluminum oxide | N/A | 3600 |
| Carbon Dioxide | 0.10 | 250 |
| Carbon monoxide | 0.37 | 2100 |
| Hydrogen | 0.12 | 200 |
| Hydrogen chloride | 0 | 2100 |
| Lead | N/A | N/A |
| Nitrogen | 0.11 | 850 |
| Water | 0.19 | 850 |
| Other | N/A | 100 |
| | DOUBLE –BASE PROPELLANT ROCKET MOTOR | |
| Aluminum chloride | 0 | N/A |
| Aluminum oxide | 9.9 | N/A |
| Carbon Dioxide | N/A | 175 |
| Carbon monoxide | 6.5 | 333 |
| Hydrogen | 0.8 | 8 |
| Hydrogen chloride | 5.7 | N/A |
| Lead | N/A | 11 |
| Nitrogen | 1.8 | 102 |
| Water | N/A | 125 |
| Other | 0.4 | 0 |

#### *4.1.5.4.2 Airport Operations*

Aircraft are exempt from the Commonwealth of Virginia regulations that govern emissions standards for mobile sources (9 VAC 5-40-5680). Aircraft operating from the Wallops Flight Facility generally have reciprocating, turboprob, or jet engines. Most of the aircraft use JP-5 fuel, although ER-2 aircraft use JPTS fuel, and small amounts of 100-octane low-lead gasoline are used (Reference 53). Emissions of concern are primarily hydrocarbons that disperse readily in the atmosphere. A portion of those emissions may be Volatile Organic Compounds, which are associated with the generation of ground level ozone. However, the volume of aircraft operations at the Wallops Flight Facility is relatively small and the area is considered to be an attainment area for ozone levels (Reference 53).

#### *4.1.5.4.3 Open Burn/Open Detonation Area*

Under EPA interim permitting status, Wallops Flight Facility operates an Open Burn/Open Detonation area, located on the southern end of Wallops Island. The Wallops Flight Facility has submitted an application to operate as a treatment, storage, and disposal facility under the Resource Conservation and Recovery Act. The permit is currently under review by the Commonwealth of Virginia Department of Environmental Quality (References 53, 108 and 109).

Rocket motors that do not meet launch specifications after preflight inspections are thermally destroyed in the Open Burn/ Open Detonation area. The thermal treatment renders the rocket motors non-hazardous by burning off all propellants. On average, the Open Burn/ Open Detonation area is used 4 days per year. The primary combustion products resulting from the thermal destruction process are the same as those resulting from launch of rockets containing these motors. The combustion products include carbon monoxide, carbon dioxide, water, nitrogen, hydrogen, hydrogen chloride, aluminum oxide, and lead. Summaries of the chemical composition and the maximum frequency of destruction of rocket motors are presented in Table 4-19. An estimated 75 tons (68 tonnes) of propellant are thermally destroyed in the Open Burn/ Open Detonation area each year (Reference 50, 108 and 109).

**TABLE 4-19**
**SUMMARY OF OB/OD AREA OPERATIONS**

| | ROCKET MOTORS DESTROYED | | |
|---|---|---|---|
| | Nike | Orion | Spin |
| Propellant (lbs each) | 780 | 620 | 2 |
| Burn Time (seconds each) | 3.5 | 20 | < 1 |
| Est. Number to be Treated (annually) | 6 | 6 | 12 |
| CHEMICAL COMPONENTS PRESENT | | | |
| Nitrocellulose | X | | X |
| Nitroglycerine | X | | X |
| Nitroguanidine | | X | |
| Ammonium perchlorate | | X | |
| Aluminum | | X | |

Note: Nike, Orion, and Spin Motors are common examples of motors destroyed at the OB/OD area. (Reference 50)

#### *4.1.5.4.4 Central Boiler Plant*

The Central Boiler Plant is located in Building D-8 on the Main Base and uses three boilers from October through May. The stacks on the three boilers are permitted by the Commonwealth of Virginia. Up to 37 individual boilers are used to provide heat to buildings not serviced by the Central Boiler Plant.

Two back-up diesel generators are operated at the Central Boiler Plant on an as-needed basis. One of the generators is used to supply power to mission-essential buildings in the event of a power failure or a low-voltage warning from Conectiv. Sites on the Mainland and Wallops Island are all heated by individual boilers with individual fuel supplies (Reference 53). Emissions generated by the Central Boiler Plant and the individual boilers from combustion of hydrocarbons may include particulates, sulfur dioxide, carbon monoxide, nitrogen oxides, and volatile organic compounds.

#### *4.1.5.4.5 Plating and Industrial Shops*

The electroplating shop is located in Building F-8 on the Main Base. Air emissions from the facility, including caustic vapors, result from the electroplating process. Industrial shops are located in Buildings F-10 and F-16.

#### *4.1.5.4.6 Paint Spray Booths*

Paint spray booths are located in Buildings F-16, F-10A, and N-159 on the Main Base and in Building X-30 on Wallops Island. The spray booths have filtering efficiencies of 94 percent. The emissions of volatile organic compounds from all booths are less than the exemption levels subject to permitting requirements (Reference 101).

In accordance with 9 VAC 5-40-210 of the Virginia Regulations for the Control and Abatement of Air Pollution, Wallops Flight Facility submitted data in 1990 to the Department of Air Pollution Control regarding operations of the NASA paint booth facilities, including paint usage information. The Department of Air Pollution Control found, through modeling, that Wallops Flight Facility emits 33 non-criteria toxic air pollutants. Twenty-one of those pollutants, are exempt from regulations. The remaining 12 non-criteria pollutants are subject to regulation. Based on the data provided to Department of Air Pollution Control, Wallops Flight Facility is in compliance with regulations for non-criteria pollutant emission rates. Any increase in emissions (i.e. increased paint usage) must be reported to the Department of Air Pollution Control to ensure continued compliance. A summary of the Department of Air Pollution Control's findings is presented in Tables 4-20 and 4-21.

**TABLE 4-20**
**SUMMARY OF EMISSIONS FROM PAINT SPRAY BOOTHS**

| EXEMPT NON-CRITERIA AIR POLLUTANTS | | | |
|---|---|---|---|
| POLLUTANT NAME | CAS NUMBER | UNCONTROLLED EMISSION RATE (lb/hr) | EXEMPTING RATE (lb/hr) |
| n-Butyl acetate | 123-86-4 | 5.2 | 126.77 |
| n-Butyl alcohol | 71-63-3 | 6.4 | 12.90 |
| Ethyl benzene | 100-41-4 | 0.8 | 63.51 |
| Ethyl benzene | 107-21-1 | 1.1 | 12.9 |
| Ethylene glycol Monopropyl ether | 2807-30-9 | 4.7 | 63.51 |
| Isobutyl acetate | 110-19-0 | 0.4 | 126.7 |
| Isobutyl alcohol | 78-83-1 | 0.2 | 12.90 |
| Isopropyl alcohol | 67-63-0 | 10.3 | 126.77 |
| Magnesium naphthenate | 1336-93-2 | 0.1 | 0.76 |
| Methyl ethyl ketone | 78-93-3 | 0.5 | 126.77 |
| Methyl isobutyl ketone | 108.10-1 | 3.8 | 12.90 |
| Mica | 12003-38-2 | 0.1 | 0.76 |
| Nitroethane | 79-24-3 | 1.2 | 63.51 |
| 2-Nitropropane | 79-46-9 | 2.3 | 6.58 |
| Polypropylene glycol Monomethyl ether | 107-98-2 | 1.7 | 63.51 |
| Polypropylene glycol Monomethyl ether acetate | 108-65-6 | 3.4 | 126.77 |
| Stoddard solvent | 8052-41-3 | 0.3 | 126.77 |
| Toluene | 108-88-3 | 5.3 | 63.51 |
| Trimethyl benzene | 25551-13-7 | 0.3 | 12.90 |
| VM&P Naptha | 8032-32-4 | 12.1 | 126.77 |
| Xylene | 1330-20-7 | 10.8 | 63.51 |

**TABLE 4-20**
**SUMMARY OF EMISSIONS FROM PAINT SPRAY BOOTHS**

CAS Number – Chemical Abstract System identification number.
Uncontrolled Emission Rate – Emission rate of facility modeled.
Exempting Rate – Maximum allowable emission rate.
Lb/hr – pounds per hour.

(Reference 20)

**TABLE 4-21**
SUMMARY OF EMISSIONS FROM PAINT SPRAY BOOTHS
REGULATED NON-CRITERIA AIR POLLUTANTS

| POLLUTANT NAME | CAS NUMBER | EMISSION RATE (lb/day) | PREDICTED AMBIENT CONCENTRATION ($\mu g/m^3$) | SIGNIFICANT AMBIENT CONCENTRATION ($\mu g/m^3$) |
|---|---|---|---|---|
| Aluminum oxide | 1344-28-1 | 77.0 | 14.9 | 166.7 |
| Aluminum silicate | 1335-30-4 | 18.4 | 3.6 | 166.7 |
| Barium metaborate Monohydrate | 13701-59-2 | 8.8 | 1.7 | 8.3 |
| Calcium carbonate | 1317-65-3 | 30.8 | 6.0 | 166.7 |
| Cobalt napthenate | 61789-51-3 | 1.0 | 0.2 | 1.7 |
| Iron oxide | 1309-37-1 | 9.6 | 1.9 | 83.3 |
| Magnesium silicate | 14807-96-6 | 13.2 | 2.6 | 166.7 |
| Phosphoric acid | 7664-38-2 | 18.3 | 3.6 | 16.7 |
| Silica, amorphous Fused | 60676-86-0 | 4.0 | 0.8 | 1.7 |
| Silica, diatomaceous Earth | 68855-54-9 | 27.9 | 5.4 | 166.7 |
| Titanium dioxide | 13463-67-7 | 38.4 | 7.5 | 166.7 |
| Zinc borate | 1332-07-5 | 8.7 | 1.7 | 166.7 |

Predicted Ambient Concentration – Concentration of toxic pollutant in ambient air based on modeling and emission rate data.
Significant Ambient Concentration – Concentration of a toxic pollutant in the ambient air which if exceeded may have the potential to injure human health.
Lb/day – pounds per day
$\mu g/m^3$ – micrograms per cubic meter

(Reference 20)

### 4.1.6 Radiation

#### 4.1.6.1 Introduction

Uses of radiation-emitting materials and equipment at Wallops Flight Facility include space flight research, earth sciences research, atmospheric research, testing and integration of space flight hardware, and communications. Radiation-emitting materials and equipment can be classified as either ionizing or non-ionizing radiation. Ionizing radiation is any type of radiation capable of directly or indirectly producing ions as it passes through a medium. In general, ionizing radiation has considerably greater kinetic energy than non-ionizing radiation. Non-ionizing radiation is not strong enough to produce free ions as it passes through media (Reference 52).

Sources of ionizing radiation at Wallops Flight Facility include: x-ray producing equipment, a variety of devices such as tritium exit signs and ionizing smoke detectors, and radioactive materials used for instrument calibration. Equipment in use at Wallops Flight Facility that produces non-ionizing radiation includes: lasers, radars, microwaves, and ultraviolet and high-intensity lamps.

Radiation-emitting materials and equipment are used and/or stored at Wallops Flight Facility under a comprehensive radiation protection program. NASA's Safety Office administers the program, and the Radiation Safety Committee provides oversight. The Radiation Safety Committee governs the use of both ionizing and non-ionizing radiation sources, which are used primarily at Goddard Space Flight Center and Wallops Flight Facility, but can also be used at temporary NASA project sites throughout the United States and the world.

The Federal Nuclear Regulatory Commission (NRC) licenses use and storage of ionizing source material, special nuclear material, and byproduct material (Reference 52). Source material is any radioactive material, except special nuclear material, which contains at least 0.05 percent by weight of uranium and/or thorium. Special nuclear material is plutonium, uranium 233, or uranium enriched in the isotope 233 or 235. Byproduct material is any radioactive material, except special nuclear material, that is derived from production or use of special nuclear material (Reference 52).

The NRC does not license sources of electromagnetic radiation, which may be either ionizing or non-ionizing. Electromagnetic radiation is energy from electric and magnetic fields which includes: x-rays and gamma rays (both ionizing), ultraviolet, visible, infrared, and radio frequency waves (all non-ionizing). These different forms of radiation occupy various portions of the electromagnetic spectrum and differ only in frequency and wavelength (Reference 44).

The NRC has issued license number 19-05748-02 to NASA for some types of ionizing radiation in use at Wallops Flight Facility, including the many byproduct materials used as calibration sources (Reference 77). License 19-05748-02 is held at the Greenbelt facility since use and storage of the majority of sources occurs at that facility. Occasionally, however, the sources are brought to Wallops Flight Facility for instrument calibration and other research needs. Additional data on these licenses may be found in Section 4.1.6.2.1, Licensed Sources. Sources

of ionizing radiation not regulated by the NRC include x-ray producing machines, particle accelerators, accelerator-produced radioisotopes, and radium and its daughter products. In Virginia, the Department of Health Radiological Health Program licenses these sources of ionizing radiation. Moreover, NASA's Radiation Safety Committee governs possession and use of these sources, which are subject to NASA's GSFC and Federal regulations on radiological safety (Reference 52). Non-NRC-licensed sources of ionizing radiation are discussed in Section 4.1.6.2.2. Equipment producing non-ionizing radiation is not licensed by NRC. The radiation Safety Committee provides oversight of non-ionizing radiation equipment to ensure protection of the safety of personnel and the public (Reference 44). Non-ionizing radiation is discussed in Section 4.1.6.3.

### 4.1.6.2 Ionizing Radiation

#### *4.1.6.2.1 Licensed Sources*

The NRC issues broad licenses to large facilities with comprehensive radiological protection programs. Broad licenses authorize possession of a wide variety of radioactive materials without listing of each radionuclide. Generally, Broad Type A licenses authorize possession of any byproduct material with an atomic number between 1 and 83, in any chemical or physical form. Holders of Type A licenses must have a Radiation Safety Office and a committee to act in the place of the NRC in making day-to-day program decisions (Reference 77). NASA has a NRC-issued Broad Type A License (Number 19-05748-02) and all licensed material must be used is under the supervision of NASA's Radiation Safety Committee.

The types and quantities of radioactive materials that are licensed by the NRC for use and storage at the NASA's GSFC facilities are listed in Table 4-22. Included are byproducts and source materials which may be used and stored at Wallops Flight Facility under NASA's License Number 19-05748-02 (Reference 77). The sources listed on Table 4-21 are licensed for long-term use and storage only at the Greenbelt facility. However, an exception for temporary use of sealed and plated sources at Wallops Flight Facility and other NASA facilities within the U.S. is made in the license (Reference 77). These sources are generally used for instrument calibration, the study of radiation effects, or in-space flight research and development projects. Specific authorized uses of the sources are defined in 10 CFR 30.4(q) (Reference 77).

As Virginia is a Non-Agreement State, the NRC licenses all facilities that store or use licensable material in Virginia. Maryland is an Agreement State and therefore assumes responsibility for regulation of facilities that use or store NRC-licensable materials. No other NRC licenses are held within a 5-mile radius of Wallops Flight Facility. The NRC licensees that are located within approximately 40 miles of Wallops Flight Facility are listed in Table 4-23.

**TABLE 4-22**
**MATERIALS AUTHORIZED FOR USE UNDER TYPE A BROAD RESEARCH AND DEVELOPMENT LICENSE**

| SOURCE | ALLOWABLE FORM | MAXIMUM QUANTITY |
|---|---|---|
| Any byproduct material with atomic numbers 1 through 83 | Any | Not to exceed 10 millicuries per radionuclide and 500 millicuries total |
| Any byproduct material with atomic numbers 1 through 83 | Sealed sources | Not to exceed 1 curie per radionuclide and 50 curies total |
| Any byproduct material with atomic numbers 1 through 83 | Plated or sealed sources | Not to exceed 16 millicuries per radionuclide and 800 millicuries total |
| Any byproduct material with atomic numbers 84 through 96 | Any | Not to exceed 1 millicurie per radionuclide and 10 curies total |
| Any byproduct material with atomic numbers 84 through 96 | Plated or sealed sources | Not to exceed 100 millicuries per radionuclide and 1 curie |
| Hydrogen 3 | Any | 200 curies |
| Iron 55 | Any | 5 curies |
| Cobalt 60 | Sealed sources | 10 curies |
| Nickel 63 | Any | 1 curie |
| Krypton 85 | Any | 110 curies |
| Iodine 125 | Sealed sources | 5 curies |
| Cesium 137 | Sealed sources | 5 curies |
| Promethium 147 | Any | 10 curies |
| Polonium 210 | Any | 10 millicuries |
| Polonium 210 | Plated or sealed sources | 5 curies |
| Americium 241 | Any | 10 millicuries |
| Americium 241 | Plated or sealed sources | 5 curies |
| Curium 244 | Any | 10 millicuries |
| Curium 244 | Plated or sealed sources | 5 curies |
| Californium 252 | Plated or sealed sources | 16.2 millicuries |
| Uranium 235 | Plated or sealed sources | 10 grams |
| Plutonium 238 | Plated or sealed sources | 50 milligrams |
| Plutonium 239 | Plated or sealed sources | 20 micrograms |

(Reference 77)

**TABLE 4-23**
**NRC LICENSEES OF RADIOACTIVE BYPRODUCT AND SOURCE MATERIAL WITHIN 40 MILES OF WALLOPS FLIGHT FACILITY**

| Facility | Program Code | Program Type |
|---|---|---|
| Cardiovascular Associates, Ltd<br>Chesapeake, VA | 02201 | |
| Chesapeake General Hospital<br>Chesapeake, Va | 02120 | Medical Institution Limited |
| Nova Chemicals (USA), Inc.<br>Chesapeake, VA | 03120 | Measuring Systems Portable Gauges |
| Radiology Services of Hampton Roads<br>Greenbrier Technology Center<br>Chesapeake, VA | 02500 | |
| IRS of America Corporation<br>Chesapeake, VA | 03121 | Measuring Systems Portable Gauges |
| Cargill, Inc.<br>Chesapeake, VA | 03120 | Measuring Systems Portable Gauges |
| Scientific Technical, Inc.<br>Chesapeake, Va | 03320 | |
| McCallum Testing Labs, Inc.<br>Chesapeake, VA | 03121 | Measuring Systems Portable Gauges |
| Shore Health Services, Inc.<br>Nassawadox, VA | 02120 | Medical Institution Limited |

(References 41, 79)
Note: A more detailed description of each program can be found in Appendix B.

#### *4.1.6.2.2 Non-licensed Sources*

The NRC does not license x-ray producing machines, particle accelerators, accelerator-produced radioisotopes, or radium and its daughter products (Reference 52). However, the Virginia Department of Health registers facilities that use equipment producing ionizing radiation. Facilities within 40 miles of Wallops Flight Facility registered by the Virginia Department of Health are listed in Table 4-23. All the facilities listed use x-ray equipment. Smoke detectors and tritium exit signs are not registered with either Virginia or Maryland. NASA's Radiation Safety Committee controls possession and use of Wallops Flight Facility sources, and requires compliance with GSFC and Federal regulations on radiological safety. Combined exposure from NRC licensed and non-licensed sources must not exceed the NRC limits stated in 10 CFR 20 (Reference 52).

Wallops Flight Facility has x-ray producing equipment on the Main Base, including two portable x-ray units for use in the inspection of rocket motors. The equipment is currently stored in Building M-15 (Reference 61). Other devices at the facility which emit ionizing radiation

include tritium exit signs and ionizing smoke detectors. No inventory of these devices exists at this time. Table 4-25 lists sources of ionizing radiation present at Wallops Flight Facility.

**TABLE 4-24**
**NON-LICENSED SOURCES OF IONIZING RADIATION (X-RAY DEVICES) GOVERNED BY VIRGINIA DEPARTMENT OF HEALTH AND MARYLAND DEPARTMENT OF THE ENVIRONMENT (WITHIN 40 MILES OF WALLOPS FLIGHT FACILITY)**

| Facility | Facility |
|---|---|
| Cardiovascular Associtates, Ltd<br>Chesapeake, VA | Chesapeake General Hospital<br>Chesapeake, VA |
| Elliott, David C.<br>Nassawadox, VA | McCallum Testing Laboratory<br>Chesapeake, VA |
| Radiology Services of Hampton Roads<br>Chesapeake, VA | Shore Health Services<br>Nassawadox, VA |
| Atlantic Cancer Center<br>Berlin, MD | Atlantic General Hospital<br>Berlin, MD |
| Atlantic Dental Association<br>Berlin, MD | Atlantic Orthopedics<br>Berlin, MD |
| Atlantic Veterinary Services<br>Berlin, MD | Berlin Animal Hospital<br>Berlin, MD |
| Bradford, David L.<br>Berlin, MD | Dentistry in the Pines<br>Berlin, MD |
| Haynes and Ott<br>Berlin, MD | Jones, Narston<br>Berlin, MD |
| Peninsula OB/GYN<br>Berlin, MD | Schiff, David M.<br>Berlin, MD |
| Barhan and Barhan<br>Crisfield, MD | Massey, Dean B.<br>Crisfield, MD |
| McCready Memorial Hospital<br>Crisfield, MD | Ramsey, Bruce C.<br>Crisfield, MD |
| Chesapeake Chiropractic<br>Princess Anne, MD | Layfield Veterinary Services<br>Princess Anne, MD |
| Lustig, David P.<br>Princess Anne, MD | McCready Outpatient Service Center<br>Princess Anne, MD |
| Princess Anne Laboratory and X-ray<br>Princess Anne, MD | Somerset Animal Hospital<br>Princess Anne, MD |
| Three Lower Counties Community Service<br>Princess Anne, MD | University of Maryland – Eastern Shore<br>Princess Anne, MD |
| Leishear, Samuel A.<br>Pocomoke City, MD | McCready Outpatient Services<br>Pocomoke City, MD |
| McNamara, Richard L.<br>Pocomoke City, MD | PRMC Pocomoke Laboratory and X-ray<br>Pocomoke City, MD |

**TABLE 4-24**
**NON-LICENSED SOURCES OF IONIZING RADIATION (X-RAY DEVICES) GOVERNED BY VIRGINIA DEPARTMENT OF HEALTH AND MARYLAND DEPARTMENT OF THE ENVIRONMENT (WITHIN 40 MILES OF WALLOPS FLIGHT FACILITY)**

| Facility | Facility |
|---|---|
| Wells, Duncan B.<br>Pocomoke City, MD | Brenner, Charles<br>Salisbury, MD |
| Burket and Burket<br>Salisbury, MD | Bushman, Joanne<br>Salisbury, MD |
| Chesapeake Animal Clinic<br>Salisbury, MD | Children's Community Dental Program<br>Salisbury, MD |
| Cox, Josephine<br>Salisbury, MD | Crouse, James<br>Salisbury, MD |
| Curry, Martin<br>Salisbury, MD | Daniel, James G.<br>Salisbury, MD |
| Deers Head Center Hospital<br>Salisbury, MD | Dormer, Bernard Jr.<br>Salisbury, MD |
| Dyer, Wilfred III<br>Salisbury, MD | Ellicott, William<br>Salisbury, MD |
| Esham and Harmon<br>Salisbury, MD | Felthoussen, Greg<br>Salisbury, MD |
| Geipe, Kathleen<br>Salisbury, MD | Genesis Center<br>Salisbury, MD |
| Glass, Beverly<br>Salisbury, MD | Gore, R. Joseph<br>Salisbury, MD |
| Heher, Joseph<br>Salisbury, MD | Holly Center<br>Salisbury, MD |
| Hopson, Alan<br>Salisbury, MD | Inoles, Joseph<br>Salisbury, MD |
| Johnson Animal Hospital<br>Salisbury, MD | Jones, Marston<br>Salisbury, MD |
| K & L Microwave, Inc.<br>Salisbury, MD | Kaputa, Bryan<br>Salisbury, MD |
| Kennan, Dana E.M.<br>Salisbury, MD | Krause, Gerald<br>Salisbury, MD |
| Kuk, Paul<br>Salisbury, MD | Maddox, Elton Jr.<br>Salisbury, MD |
| Mastella, Stephen<br>Salisbury, MD | McAllister Veterinary Services<br>Salisbury, MD |
| McLaughlin, James<br>Salisbury, MD | Morgan, W.R. III<br>Salisbury, MD |

**TABLE 4-24**
**NON-LICENSED SOURCES OF IONIZING RADIATION (X-RAY DEVICES) GOVERNED BY VIRGINIA DEPARTMENT OF HEALTH AND MARYLAND DEPARTMENT OF THE ENVIRONMENT (WITHIN 40 MILES OF WALLOPS FLIGHT FACILITY)**

| Facility | Facility |
|---|---|
| Morrison, Barrett<br>Salisbury, MD | North, Arthur<br>Salisbury, MD |
| Oeschli Chiropractic<br>Salisbury, MD | Peninsula Dental Center<br>Salisbury, MD |
| Peninsula Foot and Ankle Center<br>Salisbury, MD | Peninsula Imaging<br>Salisbury, MD |
| Peninsula OB/GYN<br>Salisbury, MD | Peninsula Orthopedic Association<br>Salisbury, MD |
| Peninsula Regional Medical Center<br>Salisbury, MD | Peninsula Regional Occupational Health<br>Salisbury, MD |
| Peninsula Surgical Group<br>Salisbury, MD | Perim, Stewart<br>Salisbury, MD |
| Rayne, Albert<br>Salisbury, MD | Reddish and Gray<br>Salisbury, MD |
| Salisbury Animal Hospital<br>Salisbury, MD | Salisbury Dental Center<br>Salisbury, MD |
| Salisbury Diagnostic and Breast Cancer<br>Salisbury, MD | Salisbury Foot and Ankle Center<br>Salisbury, MD |
| Seidel, John<br>Salisbury, MD | Seif, Robert<br>Salisbury, MD |
| Shen, Irving J.<br>Salisbury, MD | Smith, W. Ellis<br>Salisbury, MD |
| Snyder, Padley and McKelvey<br>Salisbury, MD | USAir Express<br>Salisbury, MD |
| Welsh, Debra<br>Salisbury, MD | Wicomico Veterinary Hospital<br>Salisbury, MD |
| Winter Place Animal Hospital<br>Salisbury, MD | Wycall, Theodore<br>Salisbury, MD |
| Yalich Clinic of Salisbury<br>Salisbury, MD | Bunting, William Jr.<br>Snow Hill, MD |
| Snow Hill Dental Association<br>Snow Hill, MD | Worcester County Health Department<br>Snow Hill, MD |

(References 28)

### 4.1.6.3 Non-ionizing Radiation

The Safety Office and GSFC monitor the devices at Wallops Flight Facility that produce non-ionizing radiation. Prior to using a new source, users submit forms for approval to these offices. Although no permit requirements exist for non-ionizing radiation producing devices, their uses are overseen by the Radiation Safety Committee to ensure protection of personnel, the public, and the environment. These devices include lasers (Classes I-IV), ultraviolet light sources, high intensity light sources, and radio-frequency devices such as microwave ovens, radar and radios. There are approximately 80 microwave ovens at Wallops Flight Facility. A further discussion of non-ionizing biological effects is reviewed in Appendix C. Microwave ovens are inventoried when identified. Microwave oven radiation surveys are performed upon request. On an annual basis, a radiation survey and inspection is performed on one cafeteria microwave oven.

**TABLE 4-25**
**APPROXIMATE NUMBER OF SOURCES OF IONIZING RADIATION AT Wallops Flight Facility AS KNOWN TO THE RADIATION SAFETY COMMITTEE**

| SOURCE | QUANTITY |
|---|---|
| Calibration Sources | 2 |
| Radioactive Devices | Numerous[1] |
| X-ray Producing Devices | 2 |

[1] A variety of radioactive devices exist at the facility. These include tritium exit signs and ionizing smoke detectors.

[2] X-ray devices are present at the Wallops facility but are not all listed on the current inventory.

(Reference 61)

#### *4.1.6.3.1 Radio Frequency Devices*

Radio-frequency radiation (RfR) refers to the emission and propagation of electromagnetic waves in the frequency range from 3 KiloHertz kHz to 300 Giga-Hertz GHz. Such waves are characterized as non-ionizing radiation because the intrinsic electromagnetic energy absorbed by a body at any frequency within this range is much too low to ionize (eject electrons) from molecules of the body. Radio-frequency radiation is produced by such transmitting devices as radar, telemetry, and radios. Wallops Flight Facility operates more than 100 radio-frequency radiation devices that represent the majority of non-ionizing radiation sources at the facility.

#### *4.1.6.3.2 Safety Standards for Radio-Frequency Radiation Devices*

Safety standards for radio-frequency radiation have been developed by a variety of organizations based on the current state of knowledge on the bioeffects of exposure. Human exposure guidelines for radio-frequency radiation vary and have been published by several U.S. organizations, including the Occupational Health and Safety Administration (OSHA), American National Standards Institute (ANSI), the American Conference of Governmental Industrial Hygienists (ACGIH), and the Institute of Electrical and Electronics Engineers (IEE). Other

countries and international agencies have also published standards which are not described here. NASA complies with American National Standards Institute Standards for radiation safety for radio-frequency radiation devices.

The OSHA standard for occupational exposure to radio-frequency radiation is 1 milliwatt per centimeter squared ($mW/cm^2$), averaged over a time period of 0.10 hour or less for frequencies in the range of 10 Mega-hertz (MHz) to 100 GHz. This guideline applies to both intermittent and continuous radiation.

The American National Standards Institute/ Institute of Electrical and Electronics Engineers standard, C95.1–1992, for both occupational and general public exposure to radio-frequency radiation were first published in 1982 and updated in 1992. These standards cover the frequency range of 30 kHz to 300 GHz, and were based on a maximum whole-body specific absorption rate of 0.4 W/Kg, not to be exceeded by exposures greater than 6 minutes for occupational exposure. Table 4-26 lists these standards.

The American Conference of Governmental Industrial Hygienists publishes threshold limit values (TLV's) which are also based on a maximum whole-body specific absorption rate of 0.4 W/Kg, not to be exceeded by exposures greater than 6 minutes. The American Conference of Governmental Industrial Hygienists threshold limit values, updated in 1996, is currently identical to the American National Standards Institute/ Institute of Electrical and Electronics Engineers standard.

**TABLE 4-26**
**ANSI/IEEE (1992) AND ACGIH (1996) RADIO-FREQUENCY RADIATION PROTECTION GUIDES**

| Frequency Range (MHz) | Electric Field Power Density ($mW/cm^2$) | Magnetic Field Strength (V/m) | Magnetic Field Strength (A/m) |
|---|---|---|---|
| 0.003 - 0.1 | (100, 1,000,000)[1] | 614 | 163 |
| 0.1 – 3.0 | (100, 10,000/$f^2$) [1] | 614 | 16.3/f |
| 3 – 30 | (900/ $f^2$, 10,000/ $f^2$) [1] | 1842/f | 16.3/f |
| 30 – 100 | (1.0, 10,000/ $f^2$) [1] | 61.4 | 16.3/f |
| 100 – 300 | 1.0 | 61.4 | 0.163 |
| 300 – 3000 | f/300 | | |
| 3000 – 15,000 | 10 | | |
| 15,000 - 300,000 | 10 | | |

[1]Plane-wave equivalent power density values
Note: f = frequency in MHz A = Ampers mW = milliWatts m = meter V = Volts
(Reference 38)

NASA's radio-frequency radiation exposure procedure accounts for power density, the height of the beam above the ground level, the azimuth or elevation at which the device will be oriented, the local terrain, all occupied areas in the vicinity of the operation, and the operating plan for the device. An evaluation with NASA's procedure results in the area being classified as non-

hazardous, limited occupancy areas, or denied occupancy areas. Non-hazardous areas allow for any exposure up to 10 $mW/cm^2$. Limited occupancy areas allow for exposure times of less than 0.1 hour for power densities between 10 $mW/cm^2$ and 100 $mW/cm^2$. Exposure for periods greater than 0.1-hours are allowed only for power densities of 10 $mW/cm^2$ or less. Denied occupancy areas are any areas where personnel may be exposed to power densities greater than 100 $mW/cm^2$. No exposure of any length is allowed at these high levels under NASA guidelines.

#### *4.1.6.3.3 Lasers*

Laser radiation sources include pulsed or continuous wave systems capable of producing laser light from ultraviolet to the far infrared. Lasers produce and intense, coherent, directional beam of light by stimulating electronic or molecular transitions to lower energy levels (NASA, 1978). The lasers at Wallops Flight Facility are used for research and testing, as well as communication and atmospheric research.

Laser devices are used in a variety of experiments at Wallops Flight Facility in both laboratories and on airplanes. The biological effects of laser radiation are well known. The most susceptible human organ to laser light is the human eye. The eye has the ability to refract laser light and increase the energy density of the radiation through the focusing power of the eye. The eye can be damaged or burned which can result in impairment or loss of vision.

Lasers can also affect the skin. Skin effects from laser exposure may vary from mild reddening similar to sunburn, blisters, or charring of the skin. The degree of effects from lasers depends on the wavelength, power (energy) density, exposure time, and the sensitivity of the organ being irradiated (Reference 43).

Exposure to lasers is typically more controllable than exposure radio frequency devices since lasers are used in a controlled laboratory or research settings and are often contained in sealed devices. The hazards of lasers are well known and proper handling techniques for equipment with lasers have been developed. Accidents with lasers occur most often when users are tired, under the influence of drugs or medication, or less alert for a variety of reasons. The eyes can be damaged by looking directly into the beam of light, by viewing the reflection of a laser, or by a diffuse reflection (i.e., viewing a laser image on a wall or rough surface which has been irradiated due to a scattering of the beam).

#### *4.1.6.3.4 Safety Standards for Lasers*

Human exposure safety standards are available for lasers through the same organizations that provide safety standards for radio-frequency radiation (OSHA, ANSI, IEEE and the ACGIH). Other countries and international agencies have also published standards that are not described here. NASA complies with ANSI Standard Z136.1-1993 for radiation safety for lasers.

American Conference of Governmental Industrial Hygenists publishes Threshold Limit Values for direct Ocular Exposures and skin exposure from a laser beam which cover the wavelength range of 180 nanometers to 1 millimeter (Reference 8). The laser Threshold Limit Values are intended for exposure to laser radiation under conditions to which nearly all workers may be exposed without adverse health effects. The values are to be used as a guideline and are based on the best available information from experimental studies. The maximum time allowed for

exposure is presented with each Threshold Limit Value. The Threshold Limit Values for diffuse reflection (extended sources) eye exposure are obtained through the use of correction factors.

ANSI Standard Z136.1-1993 (Reference 9) publishes a series of Maximum Permissible Exposures (MPEs) for laser radiation including Maximum Permissible Exposures for Director Ocular Exposure to a laser beam (Intrabeam Viewing) and Diffuse Reflection of a laser beam (extended source). Maximum Permissible Exposures have also been developed for skin exposure to a laser beam.

NASA's Laser Safety Program

NASA classifies all lasers into one of four categories based on use and light intensity. All of NASA's laser operators must be trained in the proper use of the class of lasers they use. NASA's safety program describes techniques for usage for each class of laser rather than placing limits on the power or intensity.

Class I lasers are considered "exempt" and are typically enclosed in a protective device. Control measures are not required for the operation of Class I lasers. These lasers can be directed at the eye or skin for a prolonged period (24-hours) without producing adverse effects.

Class II lasers are low power visible continuous wave and high pulse-rate frequency lasers. These lasers are incapable of causing eye injury within the duration of a blink. The only danger is when a user overcomes their natural aversion to bright light and stares directly into the laser beam. The majority of these devices are Helium-neon lasers with a power of 1 Mw or less.

Class III lasers are medium power lasers and laser systems. These lasers can present a potential for serious eye injury by staring directly into the beam. However, they do not generally represent a hazard for diffuse reflection, skin hazards for momentary unintentional exposure, or a fire hazard.

Class IV lasers are "high power" lasers and are usually only found in controlled research laboratory settings. These lasers can present serious skin and eye hazards and can often ignite flammable targets, create hazardous airborne contaminants, and usually have a potentially lethal high-current, high-voltage power supply.

#### *4.1.6.3.5 Other Sources*

High intensity light sources include compact arc lamps, tungsten-halogen lamps, and electronic flash lamps. Some high intensity light sources may produce ultraviolet, visible, and/or infrared radiation (Reference 45). Ultraviolet radiation is capable of producing light with wavelengths from 2000 to 4000 angstroms. Ultraviolet below 2000 angstroms is considered to be vacuum ultraviolet (Reference 45). The visible spectrum ranges from 4000 - 7000 angstroms, and infrared produces wavelengths of greater than 7000 angstroms (Reference 96). These light forms are types of non-ionizing radiation.

Sources of radio-frequency radiation which produce power densities greater than 100 milliwatts per square centimeter ($mw/cm^2$) are potentially hazardous (Reference 38). Sources of radio-

frequency radiation which fall in this category include radar units, microwave ovens, diathermy units, induction heating devices, and radio-frequency generators, all of which operate over frequencies of 10 MHz to 100 GHz. Radio-frequency radiation is monitored by the Safety Office. Radar units at Wallops Flight Facility operate with frequencies within the portion of the electromagnetic spectrum considered to be the microwave region, from 100 to 100,000 MHz. Frequencies in the microwave region are much lower than for x-rays and gamma rays, and microwaves do not cause ionization. The microwave region is between the very high frequencies (VHF), radio and infrared portions, of the electromagnetic spectrum and exhibits characteristics of both. Although microwaves do not possess sufficient energy to cause ionization, they can cause excitation of atoms with the resulting production of heat. Microwave ovens apply electromagnetic energy at frequencies between 890 MHz and 6000 MHz (Reference 43). Another microwave device at Wallops Flight Facility includes a microwave landing system. The microwave landing system uses microwaves to guide aircraft to safe landings in Instrument Flight Rules conditions (Reference 61).

There are approximately 80 radars at Wallops Flight Facility, including the MPS-26 Radar Tracking System (RADTRAC), Atmospheric Systems Research Facility Radar System ultra high frequency (UHF)-Band, AN/ASR-7, Mariners Pathfinders 1 and 2, AN/APS-80B(V) Airborne Search Radar System, and the AN/APS-128(E) Airborne Search Radar System. Wallops Flight Facility also has various telemetry and command systems, which consist of various fixed antennae, transportable systems, and the Wallops Orbital Tracking System.

### 4.1.7 Noise

#### 4.1.7.1 Introduction

Significant noise sources associated with NASA's activities at Wallops Flight Facility include vehicular traffic, aircraft traffic, and rocket launches. In general, traffic on Wallops Island is minimal, and rocket launches are infrequent. Wind, wildlife, and surface water wave action are the predominant sources of naturally occurring noise on Wallops Island. The predominant noise sources at the Mainland are traffic, wind, and wildlife. Predominant noise sources on the Main Base include aircraft operations and vehicular traffic.

#### 4.1.7.2 Noise Standards and Criteria

Noise is defined as any loud or undesirable sound. The standard measurement unit of noise is the decibel (dB), generally weighted to the A-scale (dBA), corresponding to the range of human hearing. The maximum permissible noise exposures for persons working in high noise environments are presented in Table 4-27.

Since sounds in the outdoor environment are usually not continuous, a common unit of measurement is the $L_{eq}$, which is the time-averaged sound energy level. The $L_{10}$ is the sound level exceeded ten percent of the time and is typically used to represent peak noise levels. Similarly, the $L_{01}$ and $L_{90}$ are the noise levels exceeded one percent and ninety percent of the time, respectively.

**TABLE 4-27**
**MAXIMUM PERMISSIBLE NOISE EXPOSURES FOR PERSONS WORKING IN HIGH NOISE ENVIRONMENTS**

| DURATION PER (HOURS) | SOUND LEVEL (dBA) |
|---|---|
| 8 | 90 |
| 6 | 92 |
| 4 | 95 |
| 3 | 97 |
| 2 | 100 |
| 1.5 | 102 |
| 1 | 105 |
| 0.5 | 110 |
| 0.25 or less | 115 |

DBA – decibel, A-scale Note: The values in this table apply to industrial areas and workers. The maximum permissible exposure levels were established by OSHA to protect the hearing of workers exposed on a daily basis to these noise levels as well as the duration over a lifetime of employment. (Reference 90)

The 1-hour $L_{eq}$ is the measurement unit used to describe monitored baseline noise levels in the vicinity of Wallops Flight Facility. It conforms to the requirements in 23 CFR, Part 772, and is a descriptor recommended by Federal Highway Administration (for describing noise levels during peak traffic periods.

### 4.1.7.3 Aircraft Operations

Aircraft operations are a potential source of noise to the surrounding area. A variety of military and non-military aircraft use the airfield and its airspace. A listing of the type of aircraft that may use the facility and their associated noise levels is included in Table 4-28. The aircraft using the airfield are disallowed from creating sonic booms (Reference 53). Refer to Section 2.5 for further information on aircraft and their operations.

Aircraft operations at the Wallops Flight Facility airfield are intermittent. In many cases flight patterns are over marshland or farmland with primary periods of use during daylight hours. Personnel exposed to aircraft noise during airfield operations are required to wear hearing protection (Reference 53).

Environmental Health personnel (Industrial Hygienists) conduct baseline surveys of each new operation (Noise Related Services). An example of a survey is the U.S. Army Environmental Hygiene Agency's report on the environmental noise contours analysis for future operations of the L-1011 aircraft at Wallops Flight Facility. Figure 4-14(a) illustrates the results of this report. The 65 and 75 day-night average sound level ($L_{dn}$) noise contours are identified for air operations including the L-1011 aircraft. The area within the noise contours with and without the L-1011 aircraft differ by less than 0.1 percent. This difference in area indicates the L-1011 aircraft will not significantly add to the existing noise effects of the airport operations (Reference 82).

**TABLE 4-28**
**AIRCRAFT NOISE LEVELS**

| TYPE AIRCRAFT | TAKEOFF dBA | TAKEOFF (EPNdBA) | LANDING dBA | LANDING (EPNdBA) |
|---|---|---|---|---|
| 727, 737, DC9, BAC111 | 94-100 | 92-96 | 85-90 | 97-104 |
| 707, 720, DC8 | 100-105 | -- | 94-100 | -- |
| DC10, L1011 | 90 | 95-106 | 84 | 99-108 |
| DC3, Propeller | 85-90 | -- | 75-82 | -- |
| Single-Engine Propeller | 76-90 | 77-78 | 67-77 | 87-88 |
| Multipropeller | 79-93 | -- | 70-80 | -- |
| Executive jet | 93-97 | 83-94 | 81-87 | 92-101 |
| OH58 (Ranger Helicopter) | 84 | -- | 72 | -- |
| UH1 (Huey Helicopter) | 77 | -- | 77 | -- |
| C141 (Cargo Plane) | 134 | -- | 117 | -- |

EPNdB: Effective Perceived Noise Level
(Reference 48)

Noise contours are not a precise representation of noise zones. Noise contours represent an approximation of noise zones. Actual noise impacts are influenced by variables such as geographic features, meteorology, and the receiver's perception of the sources. (Reference 82).

### 4.1.7.4 Rocket Launches

Rocket launches occur infrequently from the launch areas on Wallops Island. The marshland and water surrounding Wallops Island act as a noise buffer zone. The Wallops Island launch areas are located approximately 2.5 miles from the Mainland (Reference 53).

The noise levels generated and the noise frequency spectrum are dependent primarily upon the thrust level of the rocket motors. The largest rocket launched to date from Wallops Island is the Conestoga/COMET. An overall sound pressure level of 108 dB resulting from the these launches could extend as far as 7.5 miles from the launch site. The overall sound pressure level would be maintained for 1 to 2 seconds and then rapidly decrease. The 7.5-mile radius includes the towns of Atlantic and Chincoteague, as well as farms (Reference 31). Although this level exceeds the annoyance threshold, the noise levels attenuate rapidly, are of low frequency, and occur infrequently (Reference 53).

### 4.1.7.5 Noise Monitoring Program

In 1992, Metcalf & Eddy developed a program of noise monitoring and modeling to determine baseline noise levels for Wallops Flight Facility. Sources of noise associated with the Main Base include traffic and aircraft. However, only traffic noise was examined in detail. At the Main Base, the roadways of significance include State Route 175, State Route 798, and Mill Dam Road. All of these carry traffic to and from the Main Gate. The aircraft runways at the Main

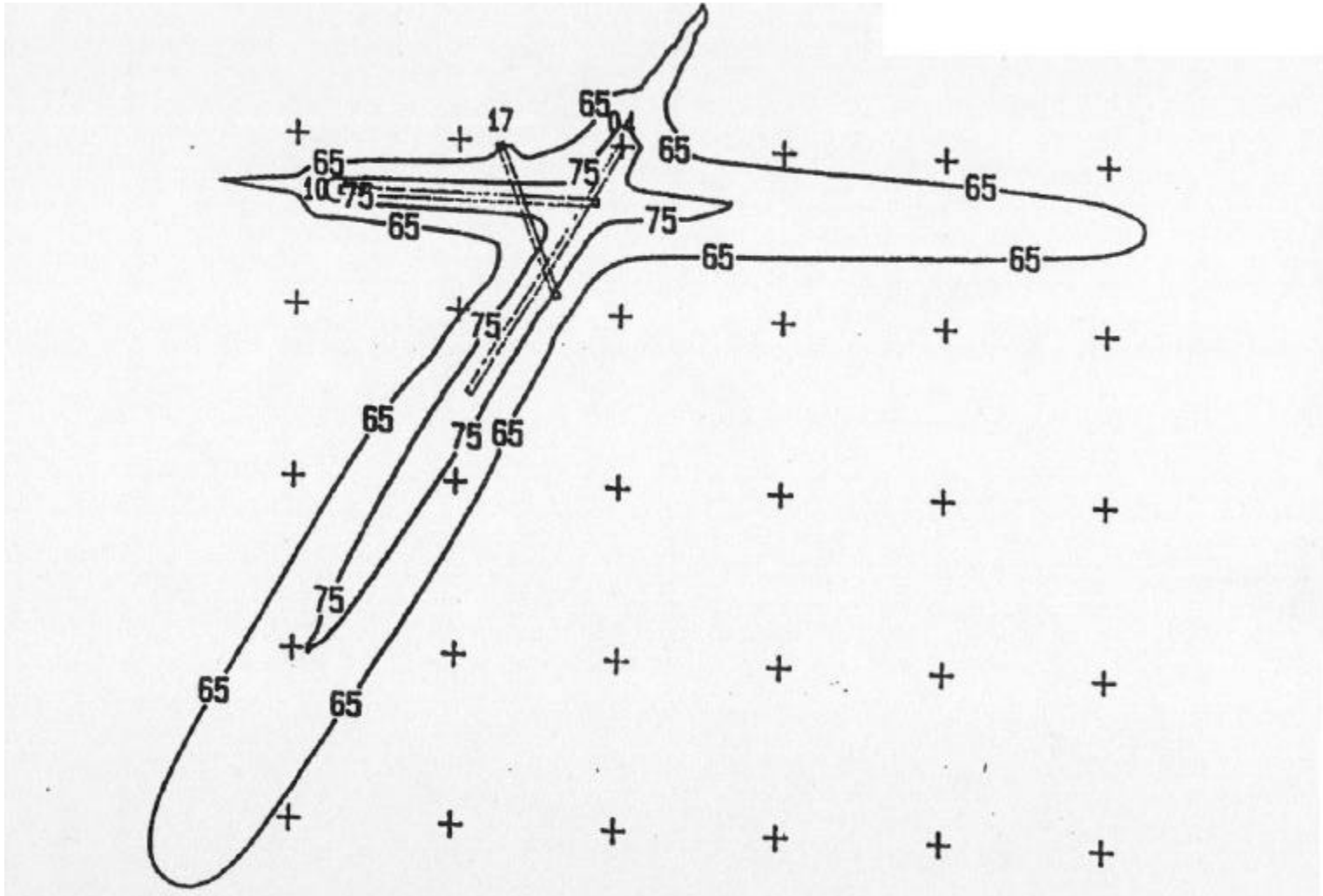



Figure 4-14 (a)

ENVIRONMENTAL NOISE CONTOURS FOR WFF AIRPORT OPERATIONS
INCLUDING THE L-1011 AIRCRAFT

Base are Runway 10-28, which is the main runway; Runway 04-22, which is used for friction testing and touch-and-go tests; and Runway 17-35, which is an infrequently used crosswind runway.

The Federal Highway Administration has established criteria for characterizing motor vehicle noise on roads constructed with Federal funds. The Federal Highway Administration criteria were used in analyzing baseline conditions because they represent established analysis for traffic noise levels. These criteria are shown on Table 4-29. An exterior $L_{eq}$ of 67 dBA is the standard typically used to evaluate outdoor noise levels along roadways. Therefore, this 67 dBA value was used to evaluate the noise levels in the vicinity of Wallops Flight Facility.

The effects of aircraft on noise levels are discussed in a qualitative manner based on monitoring data at one site. Quantitative measurement units for aircraft include the single event level (SEL) and day-night level (DNL). These units cannot be combined with the $L_{eq}$ to provide a total noise level during aircraft operations. However, during periods when aircraft activities are the dominant source of noise, the monitored data will provide information on the noise impact.

#### *4.1.7.5.1 Sensitive Receptor Locations*

Sensitive receptors include homes, schools, and parks where conversation, sleeping, or other activities would be disrupted by a noisy outdoor environment. Outdoor noise levels at the property boundary of a sensitive receptor are typically the focus of analysis. Noise levels may also be measured at the property boundary of a site that directly or indirectly generates noise (e.g., the Main Base).

Thirteen sites, shown in Figures 4-14(b) through 4-14(d), were selected for the noise-monitoring program. These are representative of the sensitive receptor locations identified in this section. Eight sites are in the vicinity of the Main Base, four are on Wallops Island, and one is in Assawoman along the route to Wallops Island.

Noise levels within the boundaries of the subject site are not usually included in a study of site-generated impacts. For this study, however, some locations within NASA boundaries were monitored, including the Coast Guard housing near Runway 10-28 on the Main Base and some sites on Wallops Island. Baseline noise levels at these sites will be useful in determining the effects of aircraft flights and rocket launches for future studies.

Most of the sensitive receptors in the vicinity of the Main Base are located along the roadways that carry vehicular traffic to and from the Main Gate. Sensitive receptors south of the facility include:

- Homes along Mill Dam Road between the Main Gate and State Route 175.
- Homes along State Route 798 between the Main Gate and State Route 175.
- Homes along State Route 175 between Mill Dam Road and State Route 798.

**TABLE 4-29**
**THRESHOLD FOR NOISE INTERFERENCE AND NOISE ABATEMENT CRITERIA (dBA)**

| Activity Category | Threshold Of Noise Interference | | Noise Abatement Criteria | | Description Of Activity Category |
|---|---|---|---|---|---|
| | $L_{10}$ | $L_{eq}(1)$ | $L_{10}$ | $L_{eq}(1)$ | |
| A (Exterior) | 48 | 45 | 60 | 57 | Tracts of land for which serenity and quiet are of extraordinary significance and which serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose. Such areas could include amphitheaters, particular parts or portions of parks, open spaces, or historic districts which are dedicated or recognized by appropriate local officials for activities requiring special qualities or serenity and quiet. |
| B (Exterior) | 58 | 55 | 70 | 67 | Picnic areas, recreation areas, playgrounds, active sports areas, and parks which are not included in Category A and residences, motels, hotels, public meeting rooms, schools, churches, libraries, and hospitals. |
| C (Exterior) | 63 | 60 | 75 | 72 | Developed lands, properties or activities not included in Categories A or B above. |
| D | --- | --- | --- | --- | For requirements on undeveloped lands see paragraphs 11a and c of Federal Aid Highway Program Manual Volume 7, Chapter 7, Section 3. |
| E (Interior) | 43 | 40 | 55 | 52 | Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals, and auditoriums. |

Note: $L_{10}$ = The sound level exceeded ten percent of the time.
$L_{eq}(1)$ = The time-averaged sound level for 1 hour.

East of the Main Base boundary, sensitive receptors include: Wallops Island National Wildlife Refuge, Wallops Visitor Center, and the Boat Basin. Sensitive receptors lie to the north and west of the Main Base, as well. Locations west of the Main Base include homes along State Route 679 directly in the flight path for Runway10-28. Locations north of Main Base include: farm residences across Little Mosquito Creek and directly in the flight path for Runway 17-35, as well as, the Trails End Campground across Little Mosquito Creek, directly in the flight path for Runway 04-22. Sensitive receptors associated with Wallops Island include homes along State Route 803, which carries traffic to and from Wallops Island.

#### *4.1.7.5.2 Field Monitoring Program*

A noise monitoring program based on Federal Highways Administration guidelines was conducted during March 10 through 13, 1992. Noise levels at each site were monitored with a B&K 2231 Noise Analyzer. The noise analyzer was placed on a five-foot tripod, and a windscreen was used at all times. A battery check and calibration of the instrument were performed before and after each monitoring period. Where possible, the tripod was 50 feet from the traveled roadway, and the site was free from obstructions that would block the noise path between roadway and receptor. Also, selected receptor sites were on residential properties or in the wildlife refuge area. Some selected residential sites were unsuitable due to site angles or accessibility. In these cases, the monitor was set up on a nearby site with conditions representative of the selected residential site.

Monitoring periods ranged from 15 minutes to 1 hour, depending on the site and predominant source of noise. A period of 1 hour was used at sites monitored during peak traffic conditions. Shorter periods were used for sites monitored during off-peak traffic and sites in natural environments where noise levels were relatively constant.

Two sites were monitored twice for comparison purposes. The site on State Route 175 across from Gate 4 was monitored during off-peak, relatively quiet conditions, as well as during aircraft touch-and-go operations. The site at the Assawoman Post Office was also monitored twice to obtain both peak and off-peak traffic conditions.

At sites along roadways, traffic counts were taken during the monitoring period for the purpose of calibrating the traffic noise analysis model. Vehicles were counted according to direction and type (i.e., autos and light trucks, medium trucks, and heavy trucks) for subsequent input to the STAMINA 2.0 traffic noise model.

#### *4.1.7.5.3 Methods of Analysis*

The Federal Highway Administration's STAMINA 2.0 computerized noise program was used to model noise levels resulting from vehicular traffic. Inputs to the STAMINA program include vehicular mix, vehicular speeds, roadway grades, ground elevations, and the physical characteristics of the roadway-receptor relationships. Additionally, the STAMINA program incorporated calculated adjustments for ground cover, barriers, and shielding effects.

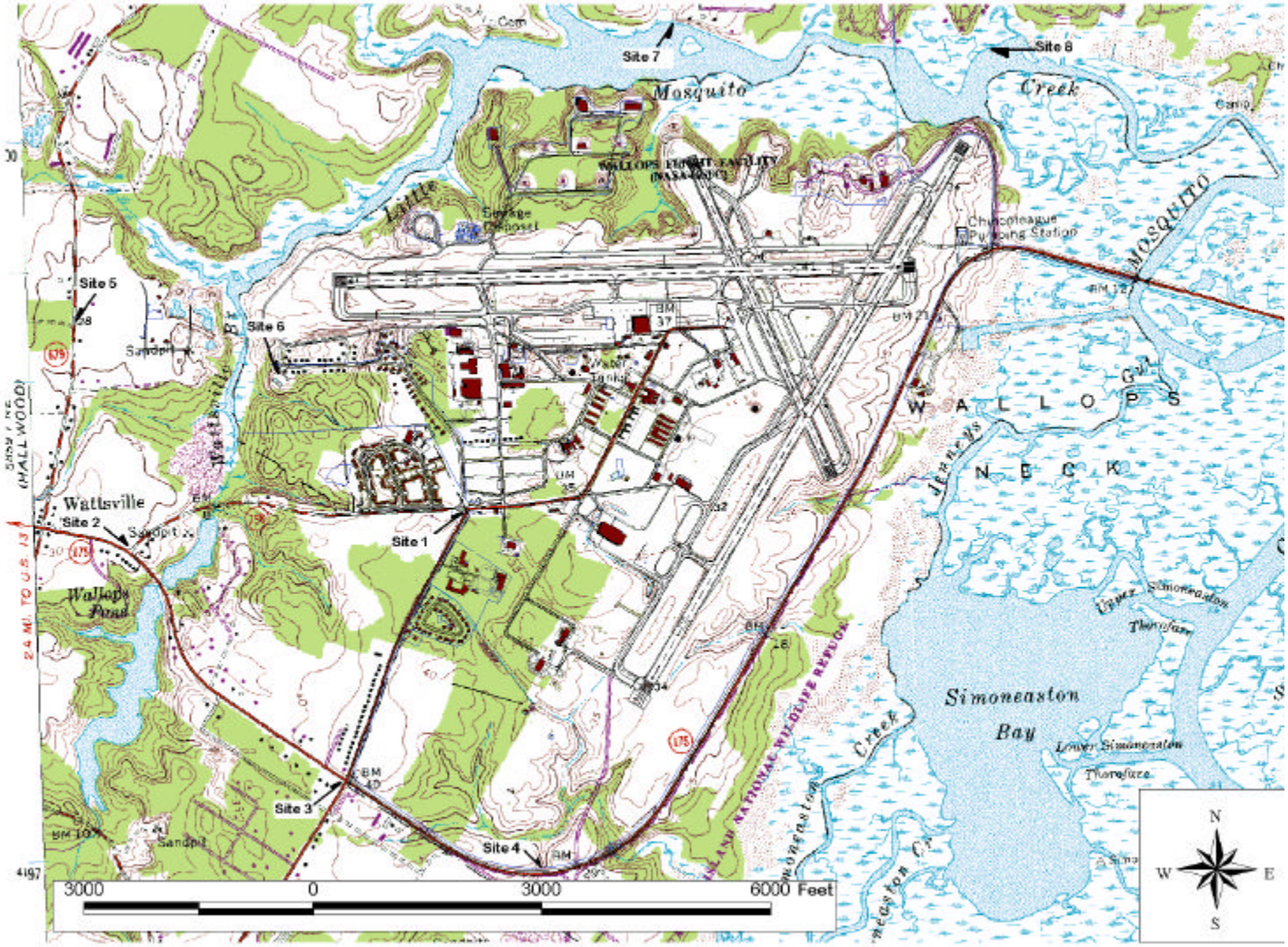



**Figure 4-14 (b)**

**Noise Monitoring Sites, MB**

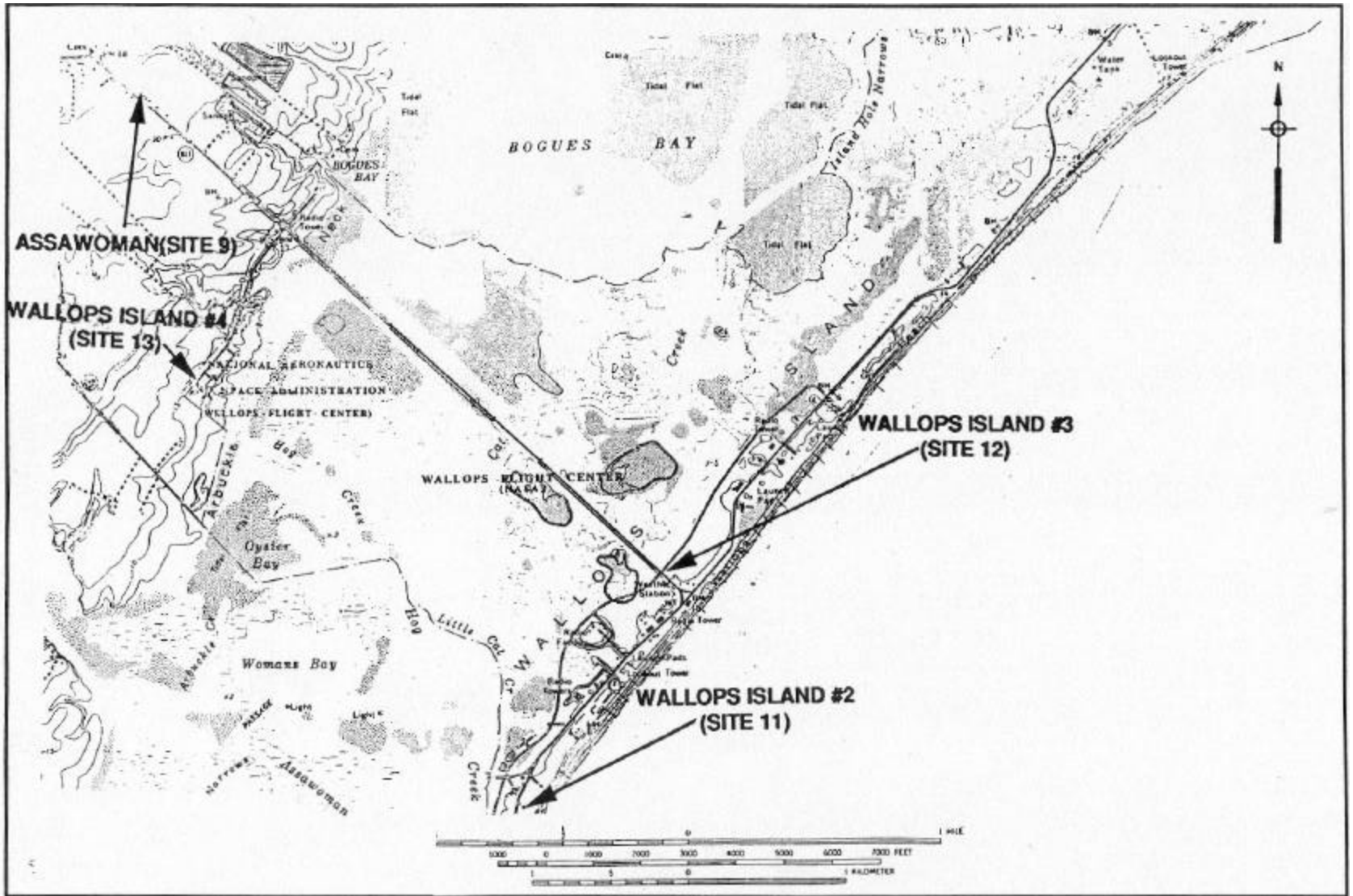



FIGURE 4-14 (c)
NOISE MONITORING
SITES- SOUTHERN WALLOPS ISLAND AND MAINLAND

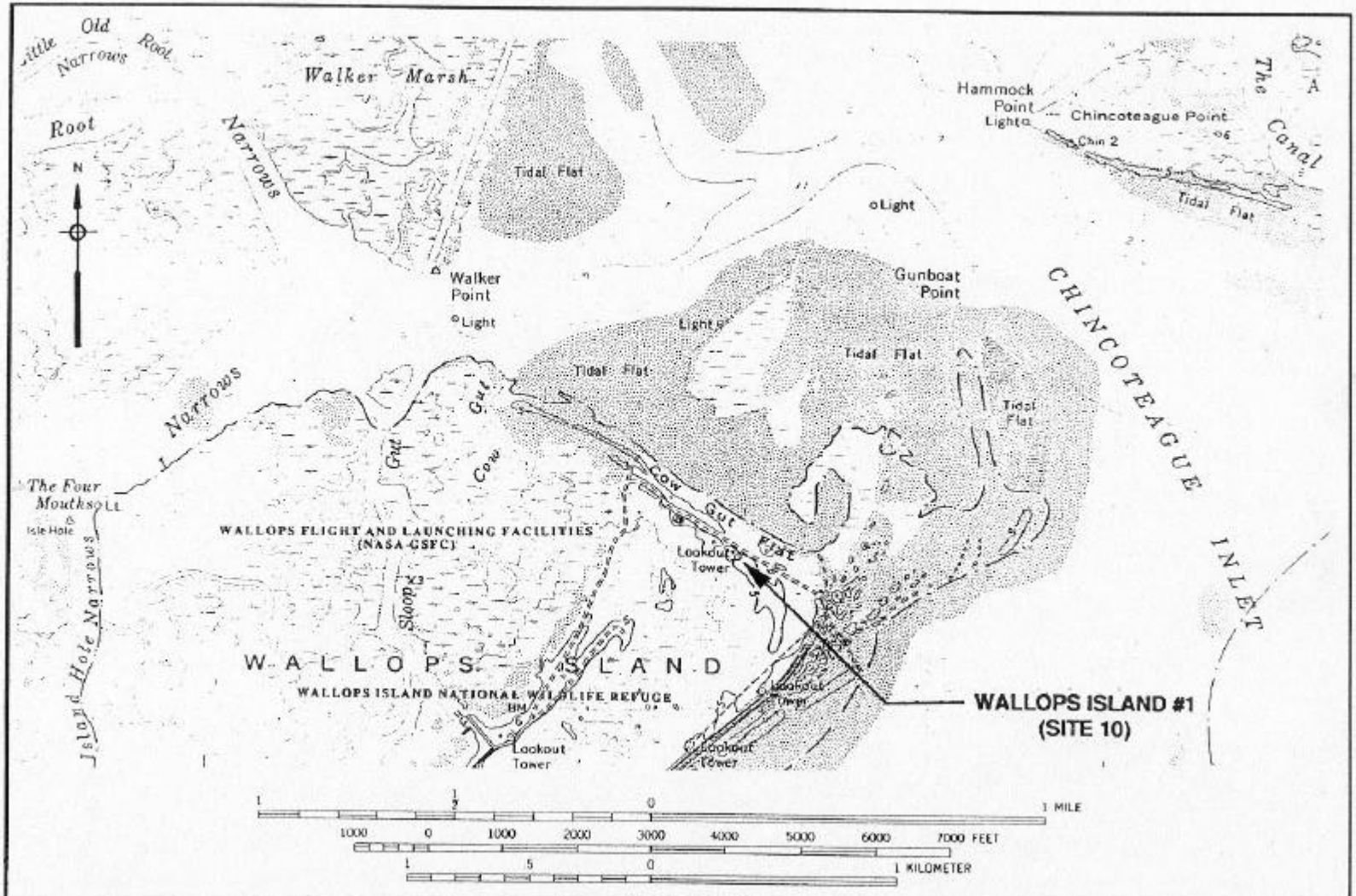



**Figure 4-14 (d)**
**NOISE MONITORING**
**SITES - NORTHERN WALLOPS ISLAND**

Table 4-30 shows the monitored and modeled noise levels based on field traffic counts. Since a change in noise level of at least 3 dBA is needed before most people will notice any difference, an acceptable range of accuracy of $\pm$ 3 dBA between monitored and modeled noise levels is typical. All modeled noise levels fell within 3 dBA of the monitored noise levels. Slight under or over predictions may be due to specific field conditions that are not represented by the model. These may include aircraft flybys, vehicles (especially trucks) with improperly maintained mufflers, or vehicles that exceed the speed limit.

Field traffic counts are typically used to identify traffic mix and directional distributions. The counts may be inappropriate for use as baseline volumes if they reflect off-peak traffic periods or months. Thus, some manipulation of data is usually necessary to develop peak AM and PM baseline volumes.

Following calibration of the model, peak AM and PM traffic volumes were developed for use in establishing 1992 baseline noise levels. At the Main Base, traffic volumes for Sites 1 through 4 are interconnected. The peak PM field traffic counts taken at Sites 2 and 3 provided a means for estimating corresponding PM traffic volumes at Sites 1 and 4. The resulting vehicular mix and directional distribution of traffic were used to allocate baseline 1992 AM and PM traffic volumes on each roadway link. Additional information on traffic is included in Appendix D.

#### *4.1.7.5.4 Baseline Traffic Noise Levels*

Information on baseline noise levels at Wallops Flight Facility is shown in Table 4-31. Noise levels during peak traffic periods are represented by the modeling levels, while off-peak periods are represented by field observations. The noise levels range from an $L_{eq}$ of 49.2 dBA at the Trails End Campground and Marina (Site 8) during off-peak traffic periods to an $L_{eq}$ of 64.7 dBA at a roadway intersection on Wallops Island (Site 12) during peak PM traffic. All but one of these baseline levels is below the 67 dBA criterion used by Federal Highway Administration. Each site is discussed in detail in Appendix D.

#### *4.1.7.5.5 Summary of Baseline Monitoring Program*

A baseline noise analysis was carried out for the NASA facilities during both peak and off-peak traffic periods. Noise sources included vehicular traffic, aircraft activities, and natural environmental sounds. Near the Main Base, sensitive receptors include homes, a campground/marina, and portions of the Wallops Island National Wildlife Refuge. Homes and buildings within the NASA boundaries are not considered to be sensitive receptors, but have been included in the analysis for comparative purposes in the event that additional analyses are carried out at a future date.

Main Base

Homes along intersections and roadways adjacent to the Main Base generally experience noise levels of 56 to 61 dBA during peak traffic periods, and 54 to 58 dBA during off-peak traffic periods. However, higher noise levels were found at the busy intersection of State Routes 175,

679, and 798. At this site, noise levels ranged from 64 to 67 dBA during both peak and off-peak periods.

Noise at homes in relatively quiet areas (away from the roadways) ranged from 49 dBA to 58 dBA, depending on the range of background noises. This range was determined for housing on the Main Base itself, and areas north of the Main Base such as Dublin Farms and Trails End Campground and Marina.

Areas near the ends of the airport runways sometimes experience noise due to aircraft operations that exceeds the 67 dBA criteria when occurring for an extended time period. The worst-case situation is represented by extended touch-and-go activities with one touch-and-go every 10 minutes. Under these conditions, the 1-hour $L_{eq}$ is 80.5 dBA several hundred feet from the end of a runway. This level would be experienced at the Trails End Campground and Dublin Farms north of the Main Base, the Wallops Island National Wildlife Refuge adjacent to the eastern boundary of the Main Base, homes along State Route 175 south of the Main Base, and some homes along Flemens Road West of the Main Base.

Wallops Island/Mainland

Activities at Wallops Island and Mainland generate traffic along State Route 803. Homes along this roadway experience baseline noise levels of 62 to 63 dBA during peak traffic periods, and 59 dBA during off-peak traffic periods.

Wallops Island contains a wide range of noise levels. At the northern portion of Wallops Island, natural sounds of wind, trees and birds are the predominant source of the 53 dBA noise levels. At the southern end of the island, as well as along the eastern shorewall, the sounds of water and waves effect a noise level of about 64 dBA. In the interior of the island, near roads and buildings, noise levels are about 61 dBA during off-peak traffic periods and 64 to 65 dBA during peak AM and PM traffic.

### 4.1.8 Solid Waste

#### 4.1.8.1 Introduction

This section includes discussions pertaining to solid waste generation and disposal, recycling programs, and a summary of the Regional Waste Generation and Management Plan. The discussion pertaining to solid waste generation and disposal focuses on the quantity of municipal, hazardous, and septage/sludge wastes generated by NASA and the means of disposal. Section 4.1.8.3, Recycling Program, outlines the Federal Recycling Program, Wallops Flight Facility programs, and actual quantities recycled by wallops Flight Facility. The summary of the Regional Waste Generation and Management Plan focuses on the Accomack-Northampton Planning District waste management goals for the future.

**TABLE 4-30**
**Wallops Flight Facility NOISE LEVELS (dBA)**

| | | FIELD CONDITIONS | | PEAK TRAFFIC PERIOD | | |
|---|---|---|---|---|---|---|
| MONITORED SITE REPRESENTATION | MODELED $L_{eq}$ | $L_{eq}$ | AM DIFF. | PM $L_{eq}$ | $L_{eq}$ | |
| MB AREA | | | | | | |
| 1 Mill Dam Rd./Rte 798 | Homes, wooded area | 57.0 | 58.4 | 1.4 | 56.9 | 57.4 |
| 2 Mill Dam Rd./Rte 175 | Single family homes | 57.7 | 60.6 | 2.9 | 58.5 | 60.6 |
| 3 Rte 175/Rte 697/ 798 | Single family homes | 65.0 | 65.6 | 0.6 | 64.3 | 64.3 |
| 4 Gate 4 | Wildlife refuge | 63.1 | 63.8 | 0.7 | 64.5 | 67.2 |
| 4A Gate 4, Touch & Go x 2 | Wildlife refuge | 80.5 | N/A | N/A | N/A | N/A |
| 5 Flemens Road | Single family homes | 55.7 | N/A | N/A | N/A | N/A |
| 6 Coast Guard Housing | Homes | 52.4 | N/A | N/A | N/A | N/A |
| 7 Dublin Farms | Farm, residence | 57.7 | N/A | N/A | N/A | N/A |
| 8 Trails End Campground | RV campground, marina | 49.2 | N/A | N/A | N/A | N/A |
| STATE ROUTE 803 | | | | | | |
| 9 Assawoman P.O. | Homes | 62.0 | 59.4 | -2.6 | 61.9 | 62.8 |
| 9A Assawoman P.O. | Homes | 64.4 | 61.9 | -2.5 | 61.9 | 62.8 |
| Wallops Island | | | | | | |
| 10 WI 1 | Observation tower | 52.5 | N/A | N/A | N/A | N/A |
| 11 WI 2 | Launch Pad 0 | 63.5 | N/A | N/A | N/A | N/A |
| 12 WI 3 | Sp. Proj. & Camera Site | 63.1 | 61.4 | -1.7 | 64.4 | 64.7 |
| 13 WI 4 | Building U-30 | 61.1 | N/A | N/A | N/A | N/A |

### 4.1.8.2 Solid Waste Generation and Disposal

#### *4.1.8.2.1 Solid Waste*

Non-hazardous solid waste generated by Wallops Flight Facility operations is deposited into dumpsters that are located throughout Wallops Flight Facility. A private disposal service, under contract to Facilities Management Branch, collects and disposes of all solid waste contained in these dumpsters. Wallops Flight Facility generated and disposed of an estimated 309 tons of municipal solid waste in 1998.

#### *4.1.8.2.2 Hazardous Waste*

The regulations which govern hazardous waste management are 40 CFR 260-270 (Federal) and 9VAC20-60 (Commonwealth of Virginia). The Environmental Office manages hazardous wastes generated at Wallops Flight Facility. They are responsible for tracking manifests and certificates of disposal for hazardous wastes, which leave the facility. The Environmental Office also provides annual Hazardous Waste training to all Civil Service and Contractor employees who handle hazardous waste as part of their job.

The generators at each operation or activity are responsible for:

- Properly containing waste.
- Properly completing and transferring of a disposal inventory sheet to the Environmental office.
- Properly labeling waste containers with information pertaining to the contents and with the words: "Hazardous Waste.

The Hazardous Waste Technicians at each operation or activity are responsible for:

- Inspecting the material.
- Transporting the waste to an accumulation area.

Building B-29 is the accumulation area for hazardous wastes on the Main Base. Buildings N-223 and E-2 are also classified as accumulation areas. Building N-223 is the Main Base facility for the storage of used oil. Building E-2 is used to store photographic process waste. Additionally, an accumulation area is located on the Mainland at Building U-81 for storage of wastes generated on the Mainland and Wallops Island.

The Environmental Protection Agency (EPA) Generator Identification Number for the Main Base is VA8800010763. The Main Base is classified as a large-quantity generator due to the fact that it generates greater than 2,200 pounds (1,000 Kg) of hazardous waste and/or 2.2 pounds (1 Kg) of acute hazardous waste per month. The Wallops Island and Mainland EPA Generator Identification Number is VA7800020888. Wallops Island and Mainland are also classified as a large quantity generator.

Hazardous waste may be stored on-site at an accumulation area for up to 90 days from the date of initial accumulation. Wallops Flight Facility uses a licensed hazardous waste transporter to transport hazardous waste to a licensed treatment, storage, and disposal Facility (TSDF). Table

4-31 lists the major generation points of hazardous waste on the Main Base. Table 4-32 lists the major generation points of hazardous waste streams on Wallops Island and Mainland.

A treatment storage and disposal facility is maintained on the southern end of Wallops Island. At the present time, the treatment storage and disposal facility is operating under interim status pending approval of a Resource Conservation and Recovery Act Part B permit. Rocket motors are treated at the facility by open burning/open detonation until the casings are certified to be free of contamination.

The 1998 Biennial Hazardous Waste report indicates that in 1997 Wallops Flight Facility generated and disposed of 28,558 pounds (12,954 kilograms) of hazardous waste from the Main Base and 4,961 pounds (2,250 kilograms) from the Mainland and Wallops Island.

#### *4.1.8.2.3 Septage/Sludge*

The northern portion of Wallops Island and the Mainland utilize septic systems. Presently, the Wallops Flight Facility Facility Management Branch is responsible for pumping out and transporting the septage to the Main Base Federally Owned Treatment Works (FOTW). The septage is dried in the sludge drying beds and liquids are recycled back through the head of the system. Facilites Management Branch maintains records regarding the quantity of septage removed from the septic systems.

Remote areas of Main Base also use septic systems. The septage removed from these septic systems is pumped out and transported to the Federally Owned Treatment Works.

The Federally Owned Treatment Works treats the wastewater from all the non-septic system buildings on Main Base and Wallops Island. The Federally Owned Treatment Works design capacity is 0.3 MGD. The average daily flow through the facility is 70,000 to 80,000 gallons (264,980 to 308,833 liters). Additional information on the Federally Owned Treatment Works is included in Section 4.1.3.1.2, Wastewater. The facility generates approximately 20,306 pounds (9,210 kilograms) of dry solids per year. The Wallops Flight Facility Sludge Management Plan specifies disposal of sludge at the Accomack County Landfill-Oak Hall, Virginia.

Prior to disposal, the sludge is analyzed for heavy metals. Only non-hazardous sludge may be disposed of at a municipal landfill. Analysis of the sludge has not indicated contaminants above regulatory limits (Reference 60).

**TABLE 4-31**
**MAIN BASE MAJOR WASTE STREAMS**

| BUILDING | DESCRIPTION | HAZARDOUS WASTE/ WASTE OIL STREAMS |
|---|---|---|
| A-41 | Radar/FPQ-16 | Recycled Oils |
| B-31 | General Warehouse | Excess Materials |
| D-8 | Boiler House | Naphtha-Recycled; Recycled Oils |
| E-2 | Photo Lab | Photographic Chemicals; Silver Recovery |
| F-8 | Plating Shop | Electroplating Wastes |
| F-10 | Machine Shop<br>ACS Laboratory | Contaminated Coolant; Recycled Oils<br>Corrosives; Freon; Lithium Batteries |
| F-16 | Paint Shop<br>A/C Shop<br>Electrical Shop<br>Auto Shop (Garage) | Waste Paint Related Material<br>Freon 11/12; Recycled Oils<br>Florescent light tubes<br>Lead Acid Batteries-Recycled<br>Naphtha-Recycled; Fuels; Recycled Oils |
| F-160 | Chemistry Lab | Standard Lab Wastes |
| N-159 | Aircraft Maintenance Shop | Flammable Liquids; Naphtha; Recycled Oils, Nickel-Cadmium batteries |
| N-168 (Reference 107) | ADAS | Naptha-Recycled; Recycled Oils |

**TABLE 4-32**
**WALLOPS ISLAND and MAINLAND – MAJOR WASTE STREAMS**

| BUILDING | DESCRIPTION | HAZARDOUS WASTE/ WASTE OIL STREAMS |
|---|---|---|
| U-25/30 | SPANDAR Radar Operation | Recycled Oils |
| U-70 | AN/FPQ-6 Radar | Flammable Liquids; Recycled Oils |
| V-10/20 | Naval Operations | Expired Materials |
| W-15/40 | Range Ground Support (Navy) | Fuels; Recycled Oils |
| X-30 | Paint Shop | Waste Paint Material |
| V-24 | Naval Operations | Citric Acid; Trisodium Phosphate |

### 4.1.8.3 Recycling Program

#### *4.1.8.3.1 Federal Recycling Program*

Wallops Flight Facility is implementing the Federal Agency Recycling and the Council on Federal Recycling and Procurement Policy, Executive Order 12780 of October 31, 1991 (Reference 33). Highlights of this policy are summarized below:

The purposes of this Executive Order are to:

- Require that Federal agencies promote cost-effective waste reduction and recycling of reusable materials from wastes generated by Federal Government activities.

- Encourage economically efficient market demand for designated items produced using recovered materials by directing the immediate implementation of cost-effective Federal procurement preference programs favoring the purchase of such items.

- Provide a forum for the development and study of policy options and procurement practices that will promote environmentally sound and economically efficient waste reduction and recycling of our Nation's resources.

- Integrate cost-effective waste reduction and recycling programs into all Federal agency waste management programs to assist in addressing national solid waste disposal problems.

- Establish Federal Government leadership in addressing the need for efficient State and local solid waste management through implementation of environmentally sound and economically efficient recycling.

The above items are to be accomplished through implementation of actions that include:

- Each Federal agency that has not already done so shall initiate a program to promote cost-effective waste reduction and recycling of reusable materials in all of its operations and facilities.

- Within 180 days (or April 28, 1992) after the effective date of this order, each Federal agency shall provide a report to the Administrator of the Environmental Protection Agency regarding the Agency's adoption of an affirmative procurement: such programs are required by section 6002(i) of RCRA (42 U.S.C. 6862(i)).

- In accordance with section 6002(i) of RCRA (42 U.S.C. 6962(i)), each Federal agency shall review annually the effectiveness of its affirmative procurement program and shall provide a report regarding its findings to the Environmental Protection Agency and to the Office of Federal Procurement Policy, beginning with a report covering fiscal year 1992.

#### *4.1.8.3.2 Wallops Flight Facility Recycling Program*

Wallops Flight Facility operates several recycling programs and continually evaluates its programs in an effort to increase the types of products which could be recycled. Office paper and aluminum cans are recycled facility wide. A paper recycling coordinator at Wallops Flight Facility provides direction for implementing the recycling program, which includes service for removal of paper and personnel training. A separate cardboard receptacle is available for

cardboard recycling. Toner cartridges are recycled through direct return to the manufacturer. Used oil, lead-acid batteries, and nickel-cadmium batteries are collected by the Environmental Office and shipped through separate private contractors. Spent solvents are recycled through a private contractor. Vehicular maintenance, the paint shops, and ground maintenance recycle anti-freeze, paint thinner, and brush/mulch respectively, in-house. The cafeteria utilizes a private contractor to recycle its kitchen grease. Finally, Wallops Flight Facility closes the recycling loop by purchasing recycled content products.

#### *4.1.8.3.3 Quantities Recycled*

Wallops Flight Facility recycled approximately 20 percent of its solid waste in 1998. Wallops Flight Facility recycled 993 gallons (3,760 liters) of spent solvents, 3705 gallons (14,025 liters) of waste oil, 26 tons (23.6 tonnes) of white paper, 33 tons (30 tonnes) of cardboard, and 285 Lead-Acid batteries in 1998.

### 4.1.9 Regulated Substances

This section includes a discussion regarding spill control and prevention measures, Emergency Planning and Community Right-to-Know Act (EPCRA), and Hazard Communication (HAZCOM) activities. The discussion of spill control and prevention measures presents a regulatory overview and a summary of the most recent Spill Prevention, Control, and Countermeasures (SPCC) Plan for the facility. The discussion of Emergency Planning and Community Right-to-Know Act presents a summary of NASA activities.

#### 4.1.9.1 Spill Control and Prevention Measures

##### *4.1.9.1.1 Regulatory Framework*

The regulations governing the preparation and implementation of Spill Prevention, Control, and Countermeasures Plans are 40 CFR Part 112, Oil Pollution Prevention and 9VAC25-101-40, Oil Discharge Contingency Plan. The Federal regulations apply to owners or operators of non-transportation related onshore and offshore facilities engaged in drilling, producing, gathering, storing, processing, refining, transferring, distributing, or consuming oil and oil products who could reasonably be expected to discharge oil in harmful quantities, as defined in 40 CFR Part 110*, Discharge of Oil into or upon the Navigable Waters of the United States or Adjoining Shorelines*. Departments, agencies, and instruments of the Federal government are subject to these regulations to the same extent as any person, except for the provisions of 40 CFR 112.6, *Civil Penalties for Violations of Oil Pollution Prevention Regulations*.

##### *4.1.9.1.2 Wallops Flight Facility SPCC Plan Background*

Due to the proximity of Wallops Flight Facility to navigable waters and the quantity of oil stored at the facility, NASA is required to prepare a Spill Prevention, Control, and Countermeasures (SPCC) Plan. The existing plan was previously revised by the Safety Office in June 1995. The Spill Prevention, Control, and Countermeasures Plan is currently being revised and incorporated into the Integrated Contingency Plan (ICP). The Environmental Office is responsible for oil spill prevention. The Spill Prevention, Control, and Countermeasures Plan is reviewed by a Registered Professional Engineer familiar with the provisions of 40 CFR Part 112 and certified in accordance with good engineering practices (Reference 59).

#### *4.1.9.1.3 Storage Capacity*

Table 4-33 summarizes the oil storage capacities at Wallops Flight Facility, including partners. Total storage capacity for all oil commodities including aboveground storage tanks (AST's), underground storage tanks (UST's), and mobile units (tank & pump trucks) is, 556,635 gallons (2,107,093 liters).

**TABLE 4-33**
**FUEL STORAGE CAPACITY**

| FUEL COMMIDITY | TYPE OF STORAGE | | | TOTAL CAPACITY (GALLONS) |
|---|---|---|---|---|
| | AST | UST | Mobile | |
| #2 Fuel Oil | 84,785 | 34,195 | 0 | 119,530 |
| #6 Fuel Oil | 250,000 | 0 | 0 | 233,000 |
| JP-5 and JPTS | 0 | 120,000 | 24,000 | 154,000 |
| Diesel Fuel | 2,700 | 10,150 | 1,100 | 12,950 |
| Gasoline | 0 | 10,000 | 300 | 10,300 |
| Kerosene | 275 | 0 | 0 | 275 |
| Off Spec. Fuel | 0 | 10,000 | 0 | 10,000 |
| Waste Oil | 0 | 16,580 | 0 | 16,580 |
| | | | | 556,635 |

#### *4.1.9.1.4 Wallops Flight Facility Spill Control and Prevention Measures*

All fueling operations are supervised by a representative from the Facilities Management Branch. This procedure ensures that preventive measures to avoid spills are followed during fueling operations.

Aboveground Spill Prevention and Control Measures. Dikes have been constructed as spill prevention and control measures around the following tank installations:

| | | | | |
|---|---|---|---|---|
| B-31 | F-24 | N-162 | V-50B | X-35 |
| B-130 | J-17 | N-224 | V-55B | X-75B |
| D-4A | M-1A | U-48 | W-15A | X-85 |
| D-4B | M-1B | U-55 | W-20 | Y-15A |
| D-9A | M-17A | U-65 | W-20A | Y-55 |
| D-9B | M-19A | U-70 | W-40B | Y-60A |
| E-134 | M-21A | V-24 | W-100A | Z-41B |
| F-20 | N-116 | V-45B | X-15 | |

Each dike wall has been designed to contain greater than 110 percent of the total volume of the tank in the event of total failure. The dikes at D-102 and D-103 have been upgraded to include a clay liner.

Underground Spill Prevention And Control Measures. Underground storage tanks are routinely inspected for leaks by ground water vapor monitoring release detection. The leak detection system includes a vapor sensing and reporting system with six vapor monitoring wells. The

overflow protection system uses concrete catch basins to retain releases. The following underground storage tanks are inspected on a monthly basis by the Wallops Logistics Team.

| | | | |
|---|---|---|---|
| D-37-1 | D-37-3 | D-37-5 | D-37-7 |
| D-37-2 | D-37-4 | D-37-6 | D-37-8 |

In addition, underground storage tanks F-26-1 and F-26-2 are continually observed by means of an electronic soil vapor monitoring system. A "stick" test is also performed three times weekly to assure that the physical quantity remaining reflects the dispensed amount from metered pumps.

Spill Response. Personnel from the Wallops Flight Facility Fire Department, Environmental Office, and Facilities Management Branch are committed (available 24-hours a day) to ensure timely response and clean-up in the event of a spill. The Spill Prevention, Control, and Countermeasures Plan lists phone numbers of contacts to be notified in the event of an emergency. The Environmental Office and Fire Department conduct spill response field training at least once per year. Response personnel have been instructed by Safety Office personnel regarding Hazard Communication procedures. At a minimum, the materials listed in Table 4-34 are stored on site for use as spill countermeasures (Reference 59).

Security. The Main Base perimeter is surrounded by a chain-link fence. Access is limited to employees, contractors, and official visitors. The Mainland and Wallops Island are located in remote areas and access is limited. The aviation fuel farm, areas D-34 and D-37, are surrounded by steel security fences and the gate is locked when the farm is unattended. All valves that permit direct outward flow of a tank's contents are locked in the off position when not in use. Lights are located around and/or near the tanks for illumination at night (Reference 59).

**TABLE 4-34**
**SPILL COUNTERMEASURES MATERIALS**

| MATERIALS | NUMBER |
|---|---|
| Absorbent Material (50 lb. bag) | 16 |
| Pig putty | 12 |
| Absorbent Pads (1-gallon capacity) | 40 |
| Absorbent Pillows (20-gallon capacity) | 12 |
| Pig-3' x 4 " | 24 |
| HAZMAT Pillow | 10 |

#### *4.1.9.1.5 Spill Potential Analysis*

An evaluation of spill potential was conducted by Wallops Flight Facility for each above-ground tank as part of the Spill Prevention, Control, and Countermeasures Plan. The analysis considered the various plausible accident sources, their probability, and the approximate magnitude of a spill in terms of discharge quantities in the event of an accident. The various plausible accident scenarios considered were: vehicular accidents, structural decay, foul play/sabotage, overfilling, and hose/fitting rupture. The probabilities of these various accidents occurring were assigned a probability number, 0 (no possibility of occurrence) to 1 (100 percent chance of occurrence). Criteria used by Wallops Flight Facility such as location, past history, age, and tank material were considered when assigning the probability numbers. The magnitudes of these various

accidents occurring were assigned a magnitude number by Wallops Flight Facility based on the percent of product expected to be discharged. The magnitude numbers are as follows:

| Magnitude Number | Percent of Contents Discharged |
|---|---|
| 1 | 1 - 25 |
| 2 | 26 - 39 |
| 3 | 40 - 60 |
| 4 | 61 - 75 |
| 5 | 76 - 100 |

The Spill Prevention, Control, and Countermeasures Plan requires a review of those tanks with high combined accident indices in order to prevent the accident type that resulted in the high index ranking. The results of the analysis are presented in Spill Potential Analysis Results (Reference 59).

#### 4.1.9.2 Emergency Planning and Community Right-to-Know

In response to the EPA, NASA conducted a survey to evaluate facilities for voluntary compliance with the Superfund Amendments Reauthorization Act (SARA) Title III. NASA found that the Centers appeared to be in compliance or had initiated efforts to comply voluntarily. NASA has advised EPA that the centers appear to have achieved the voluntary compliance goal and they will continue to monitor progress in this area of environmental responsibility.

Emergency Planning. NASA has recommended that each Center maintain chemical inventories at its facilities and notify the State of all listed materials exceeding threshold planning quantities. Wallops Flight Facility has prepared an inventory of toxic/hazardous substances which describes the quantities and locations of such chemicals used on-site. The inventory is maintained by the Environmental Office.

The following plans and procedures have been prepared to respond to a release and are on file in the Environmental Office at Wallops Flight Facility:

- Hazardous Waste Contingency Plan and Emergency Procedures
- Emergency Preparedness Plan
- Aircraft Mishap Plan
- Plant Protection Plan
- NASA Handbook (NHB1700.1) - Basic Safety Manual
- GSFC Handbook (GHB8800.2) - Environmental Handbook

#### 4.1.9.3 Hazard Communication

Written Hazard Communications Program. Wallops Flight Facility is in the process of approving a written Integrated Contingency Plan. The plan has been developed by the Environmental Office, in accordance with the Federal Hazard Communication Program. This program includes the procedures outlined below, that Wallops Flight Facility follows.

Labels. Wallops Flight Facility tags or marks each container of hazardous chemical in English with the following minimal descriptions: the name of the chemical material; chemical formula; name and address of supplier or manufacturer; and all appropriate hazard warnings.

Material Safety Data Sheets. Wallops Flight Facility has on file in each work area, Material Safety Data Sheets (MSDS) for each hazardous chemical used on site. Each Material Safety Data Sheet is in English and contains all required information. The Environmental Office has created an electronic chemical inventory that contains links to appropriate Material Safety Data Sheets. This inventory will be online and accessible to all Wallops Flight Facility personnel.

Training. Wallops Flight Facility uses the Federal Hazard Communication Training Program. Each lesson contains two types of resources: videotape and workbook (Reference 39). This course consists of the Federal Hazard Communication Standard, Chemical Fumes and Exposure Hazards, Types of Physical and Health Hazards, Controlling Chemical Hazards, Introduction to Material Safety Data Sheets and Material Safety Data Sheets Physical Hazard Information, Material Safety Data Sheets Health Hazard Information, and Using Labels and the Hazardous Chemical Inventory.

## 4.2 BIOLOGICAL FACTORS

### 4.2.1 Biological Resources

#### 4.2.1.1 Introduction

Wallops Flight Facility lies on the Eastern Shore of the Coastal Plain Province. The facility has an extensive variety of biota. The habitats of the biotic communities include barrier islands, tidal wetlands, and inland areas (Reference 40).

A diversity of plants and animals live in the area. Biologists have documented approximately 32 species of mammals and 18 amphibian species at the Chincoteague National Wildlife Refuge. Approximately 61 species of mammals exist in the general area of Wallops Flight Facility and approximately 54 species of amphibians and reptiles. Over 300 species of birds either breed (summer) or winter in the area of Wallops Flight Facility, or stop at the facility during migration. In all, approximately 934 plant species exist in the area of Wallops Flight Facility. Documented species are on Assateague Island rather than Wallops Main Base or Wallops Island, but the numbers may be expected to be nearly the same due the proximity and similar conditions. No similar documentation has occurred within the Wallops Flight Facility. The appendices provide lists of the known flora and fauna species in the Wallops Flight Facility area. The list includes scientific names of the species, the common names, and characterization. This characterization includes the relative abundance of the species in the area as well as the typical habitat or community description.

#### 4.2.1.2 Floral Species

Habitats within the Wallops Flight Facility area include dune systems, island forest, salt marsh, upland grasslands, and forest. Wallops Island has dunes systems, island forest, and marsh. The

Mainland and Main Base have marsh, upland grasslands, and upland forest. Appendix E lists potentially occurring flora species in the Wallops Flight Facility area.

#### *4.2.1.2.1 Barrier Islands*

The Eastern Shore, particularly the barrier islands, is comprised of many dynamic ecosystems. Wallops Island, a barrier island, contains various ecological succession stages that include beaches, dunes, swales, maritime forests, and marsh. Refer to Figure 4-15 for an example of various ecological succession stages on Wallops Island. These natural vegetative zones form a series of finger-like stands that merge or grow into each other. The northern and southern dune vegetation on Wallops Island directly border the salt marshes (Reference 53).

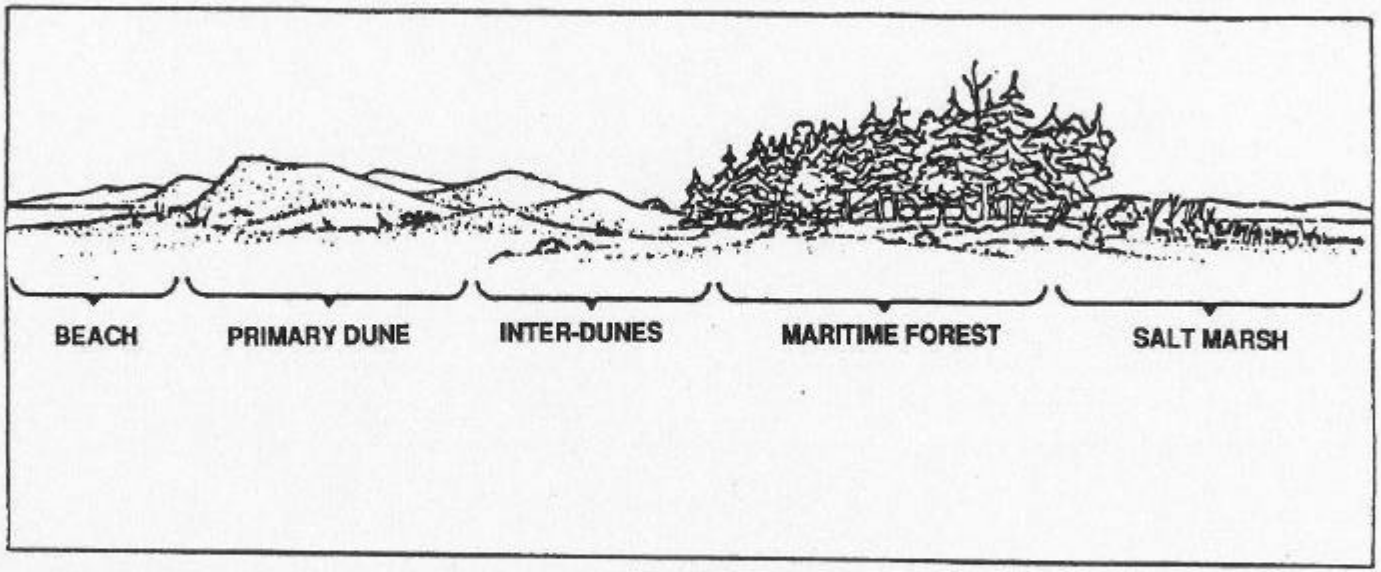
The dune system from east to west includes the sub-tidal zone, inter-tidal zone, and upper beach zone. The inter-dune swale zone includes the area located between the westernmost portion of the dune zone and the maritime zone. The dune and swale zone possesses an extremely harsh environment. Biotic resources in this zone must be very adaptable to contend with high temperatures, high winds, salt, sandblasting, drought, and low nutrient levels in the sandy soil medium (Reference 53). Dominant species within the dune system include seabeach orach *(Atriplex arenaria),* common saltwort *(Salsola kali),* sea rocket *(Cakile edentula),* American Beachgrass *(Ammonphila breviligulata)* and seaside goldenrod *(Solidago sempervirens)* (Reference 40).

The sub-tidal zone on the eastern side of Wallops Island extends from the lower limit of low tide to the seaward-most limit of wave action. Because of the dynamics of wave action, few plants exist in the sub-tidal zone. Phytoplankton are prevalent, as well as macroalgae, algae attached to substructure, and eelgrass *(Zostera marina),* in areas of diminished wave action (Reference 53).

The inter-tidal zone is a transition zone exposed during low tide and totally submerged at high tide. The inter-tidal zone is an extremely dynamic area. Plant species are virtually nonexistent in the inter-tidal zone located on the eastern portion of Wallops Island because of the deleterious effects of wave action on the stability of the zone. Microscopic plants and animals exist in the minute spaces between individual sand grains in the eastern inter-tidal zone (Reference 53).

The upper beach zone extends from the high-tide mark to the crest of the eastern-most dune. On Wallops Island this zone is found on the northern and extreme southern sections of the island. The remaining eastern section of the island is an operational area that is protected by an extensive seawall built where the upper beach zone would normally exist. Vascular plant life maintains a tenuous foothold in this area. Such plants as sea rocket and beach grass, also known as marram, are scattered on the northern part of the island (Reference 53).

On the southern part of Wallops Island, the dune and swale zone extends to the tidal marsh on the western side of Wallops Island without any maritime forest. In the middle and northern areas, the dune and swale zone extends to the maritime zone that starts where the secondary dune line once existed. The northern part of Wallops Island within the dune and swale zone is in an




Source: Hoel, M., 1986. *Lands Edge - A Natural History of Barrier Beaches Maine to North Carolina.* The Little Book Publishing Company, Newberry, MA.

**Figure 4-15**
**ECOLOGICAL STAGES ON WALLOPS ISLAND**

almost-natural state, and is dominated by northern bayberry *(Myrica pensylvanica),* wax myrtle *(M. cerifera),* groundsel-tree *(Baccharis halimifolia),* and marram (Reference 53).

The central portion of Wallops Island is dominated by the common reed *(Phragmites australis)* and by lawn areas introduced and maintained by man (Reference 53). This reed has the ability to grow in areas with very low habitat value. It is considered by many to be an undesirable plant. Due to its successful competition with many other plant species, the common reed has virtually taken over much of the area in the center of Wallops Island.

A small area of maritime forest zone exists on the central portion, with an expansive thicket zone on the northern part. The thicket zone is dominated by extensive clusters of northern bayberry, wax myrtle, and groundsel-tree. The thicket zone in some areas is virtually impenetrable due to the dense stands of poison ivy *(Rhus radicans)* and greenbriar *(Smilox spp.),* which is also pervasive on other areas of Wallops Island (Reference 53). The northern maritime forest zone is dominated by loblolly pine *(Pinus taeda)* and cherry trees *(Prunus spp.),* with an under story of the northern bayberry, wax myrtle, and groundsel-tree (Reference 53). A few places in this forest have freshwater depressions containing plants, such as duckweed *(Lemna minor)* (Reference 53).

Between Wallops Island and the Mainland stretches 1,140 acres (461.3 hectares) of tidal marsh (Reference 42). A tidal marsh is an area of low-lying wetlands that is influenced by tides. The marsh is interlaced with small streams known locally as "guts". The marsh itself can be divided into the low marsh and the high marsh - each a distinctive community in itself. The low marsh, which is inundated at high tide, is dominated by saltmarsh cordgrass *(Spartina alterniflora)* (Reference 40). The high marsh, which is flooded by approximately 50 percent of the high tides, is dominated by salt meadow cordgrass *(S. patens)* (Reference 40). The marsh is of tremendous importance to marine life and those terrestrial species that depend on the marsh for their existence. The tidal marsh is beneficial to the survival of many important species of marine and avian life. The plant life of the tidal marshes is at the beginning of the chain of marine life, with other life forms dependent on marine life (Reference 53).

#### *4.2.1.2.2 Mainland and Main Base*

The portions of Wallops Flight Facility on the Virginia mainland include the Mainland and Main Base. The vegetative zones from east to west on the Mainland and Main Base are marsh, thicket, and forest. Inland communities such as fresh and brackish marsh, xeric and mesic shrub, patches of open and complete cover of pine, and pine deciduous-mixed woodlands are often separated from one another by a sharp topographic change, forming a mosaic (Reference 88). Small rich remnants of upland forest and swamp forest occur on the Mainland and Main Base. Dominant species in the upland forest include loblolly pine, wax myrtle, black cherry *(Prunus serotina),* red maple *(Acer rubrum),* and sassafras *(Sassafras albidum)* (Reference 40). Black willow *(Salixx nigra)* and red maple are dominant species in the swamp forest (Reference 40). Salt marshes occupy 59 percent of the Mainland and Main Base (Reference 40). The Mainland and Main Base of Wallops Flight Facility include marsh located between Wallops Island and the Mainland, and the northern marsh that borders Mosquito Creek. The tidal marsh found on the Mainland and Main Base is similar to the tidal marsh on Wallops Island. Anthropogenically

influenced areas are very apparent on the Main Base. The lawns, buildings, and pavement all affect the biological area.

### 4.2.1.3 Faunal Species

The Mainland, Main Base, and Wallops Island have both terrestrial and aquatic forms of fauna that comprise the biotic communities. The tidal marshes, in particular, have a concentrated area where varieties of terrestrial and aquatic species habitate.

#### *4.2.1.3.1 Invertebrates*

Wallops Island, particularly the tidal marsh area, has an extensive variety of invertebrates. Salt marsh cordgrass marshes have herbivorous insects such as the salt marsh grasshopper *(Orchelium fidicinium)* and the tiny plant hopper *(Prokelisia)* (Reference 86). Tiny plant hopper eggs are in turn preyed upon by myriad bugs. The tidal marshes are inhabited by a number of parasitic flies, wasps, spiders, and mites. The spiders prey mostly on herbivorous insects, and mites prey primarily on microarthropods found in dead smooth cordgrass (Reference 86). Salt marsh mosquitoes *(Aedes sollicitans)* and greenhead flies *(Tabanus nigrovittatus)* are prevalent insects at Wallops Flight Facility. Appendix F includes insect and arachnid families potentially occurring in the Wallops Flight Facility area.

Species inhabit different areas of the marsh depending on their ability to adapt to the fluctuating tides. Many insects and arachnids can tolerate lengthy submersions. Insects that cannot sustain long submersions tend to move up the marsh vegetation during high tide. For example, periwinkle snails *(Littorina irrorata)* and mud snails *(Ilyanassa obsoleta)* can withstand lengthy submersions and are found mainly on the marsh surface, while the majority of the predaceous spiders which are unable to withstand submersions live within the vegetation above the mean high water level (Reference 86).

Coastal invertebrates in the Wallops Island area include calico crabs *(Ovalipes ocellatus)*, fiddler crabs *(Uca spp.)*, sand shrimp *(Cragon septemspinosa)*, moon jelly *(Aurelia aurita)*, and coffee bean snails *(Melampus bidentatus)*. The protunid crab distributions are limited by high salinities (Reference 81). Squid *(Lolliguncula brevis)* are prevalent during the winter. Appendix G includes invertebrates potentially occurring in the Wallops Flight Facility area.

#### *4.2.1.3.2 Fish*

Fisheries are influenced by changes in inlets and channels on Wallops Island. As the inlets and channels evolve, the salinity, tides, and temperature changes can result in variations in the fish species found in a given area. The dominant fish identified in this study could change with the ocean dynamics in the future.

The tidal marsh area acts as an excellent nursery due to the protection from predators and the abundance of food (Reference 81). Eelgrass, for example, provides protection to the spot *(Leiostomus xanthurus)*, the northern pipefish *(Syngnathus fuscus)*, the dusky pipefish *(Syngnathus floridae)*, and bay anchovy *(Anchoa mitchilli)* (Reference 80). Appendix H includes fish potentially occurring in the Wallops Flight Facility area.

Fish found within the bays are also found in the Atlantic Ocean. Conversely fish found in the ocean may not be found in the bays and inlets. Salinity and water depths play a major role in determining if a coastal fish could be found in the bays and inlets. An example of this is the sandbar shark *(Carcharhinus plumbeus).* The sandbar shark is one of the most common sharks in the coastal and estuarine waters near Wallops Flight Facility. If the channels located between the Mainland and Wallops Island are at least 12 feet (3.66 meters) deep and the salinity is at least 30 parts per thousand, then the sandbar shark can also live in the channels (Reference 35). Other common fish in the waters near Wallops Flight Facility include the sand shark *(Carcharias taurus),* smooth dogfish *(Mustelus canis),* smooth butterfly ray *(Gymnura micrura),* bluefish *(Pomatomidae saltatrix),* spot *(Leiostomus xanthurus),* and flounder *(Paralichthys dentatus)* (Reference 35).

#### *4.2.1.3.3 Amphibians and Reptiles*

Amphibians and reptiles use the dune and swale zones for forage. Fowler's toad *(Bufo woodhoussei)* can be found under stands of bayberry (Reference 53). The green tree frog *(Hyla cinerea)* can be found in the freshwater depressions in the northern portion of Wallops Island (Reference 53). Some species of reptiles such as the black rat snake *(Elapha obsoleta),* hognose snake *(Heterodon platyrhinos),* box turtle *(Terrapene caolina),* and northern fence lizard *(Sceloporus undulatus)* can be found in low-lying shrubs (Reference 53). Diamondback terrapin *(Malaclemys terrapin)* can be found in saltmarsh estuaries, tidal flats, and lagoons (Reference 10). Appendix I includes amphibians and reptiles potentially occurring in the Wallops Flight Facility area.

#### *4.2.1.3.4 Avifauna*

During spring and fall migrations, approximately 15 species of shorebirds are reliant on the inter-tidal zone for feeding on the microscopic plants and animals (Reference 53). Abundant among these are the sanderling *(Calidris alba),* semipalmated plover *(Charadrius semipalmatus),* red knot *(Calidris canutus),* short-billed dowitcher *(Limnodromus griseus),* and the dunlin *(Calidris alpina)* (Reference 53). The willet *(Catoptrophorus semipalmutus)* is very common during the breeding season (Reference 53). Royal tern *(Sterna maxima),* common tern *(S. antillarum),* and least tern *(S. hirundo)* can be observed during the summer. Appendix J includes avifauna species historically occurring on the Eastern Shore. For a list of avifauna occurring on Wallops Flight Facility refer to NASA Technical Memorandum 104589.

Laughing gulls *(Larus atricilla),* herring gulls *(L. argentatus),* and great black-backed gulls *(L. marinus)* commonly forage the upper beach zone and the intertidal zone. Forster's terns *(S. foresteri)* are common in the marshes and on occasion winter in the Wallops Flight Facility area. Birds that use the shrub zones include various species of sparrows, red-winged blackbirds *(Agelaius phoeniceus),* boat-tailed grackles *(Quiscalus major),* fish crows *(Corvus ossifragus),* and on rare occurrences some shorebirds (Reference 53). Birds common in the shrub zone include the song sparrow *(Melopiza melodia),* gray catbird *(Dumetella carolinensis),* and mourning dove *(Zenaida macroura)* (Reference 53).

Numerous songbirds and other avian species can be found on the Mainland and Main Base. Some of these, such as barn swallows *(Hirundo rustica),* are migratory and occur only during the spring, summer, and early fall. Mockingbirds *(Mimus sp.),* fish crows, robins *(Turdus*

*migratorius),* and starlings *(Sturnus vulgaris)* are prevalent throughout the year. Herring gulls, laughing gulls, and other less-common species occasionally can be a problem on the runways, especially during inclement weather (i.e., birds accumulating in pooled water).

#### *4.2.1.3.5 Mammals*

Mammals such as white-tailed deer *(Odocoileus virginianus),* opossum *(Didelphis marsupialis),* raccoons *(Procyon lotor),* and grey squirrels *(Sciurus carolinensis)* are plentiful. Raccoons and red foxes *(Vulpes fulva)* are occasionally found in the upper beach zone and the inter-tidal zone (Reference 53). The gray squirrel and opossum make their homes in the maritime forest along with other mammals that use other sections of the island for forage (Reference 53). Appendix K includes mammals potentially occurring in the Wallops Flight Facility area.

Mammals such as the raccoon, red fox, white-footed mouse *(Peromyscus leucopus),* meadow vole *(Microtus pensylvanicus),* white-tailed deer, and cotton tail rabbit *(Sylvilagus floridanus)* are found in the dune and swale zone (Reference 53).

### 4.2.2 Threatened and Endangered Species

#### 4.2.2.1 Introduction

Wallops Flight Facility includes a barrier island (Wallops Island) and two separate sections on the coastal region of Virginia. Wallops Island is located south of the Chincoteague National Wildlife Refuge and the Assateague Island National Seashore. The eastern portion of the Mainland borders the western side of Wallops Island National Wildlife Refuge. These refuges act as safe havens for wildlife species. Both migratory and non-migratory species benefit from these protected areas.

#### 4.2.2.2 Regulations

The Endangered Species Division of the United States Fish and Wildlife Service classifies a species as endangered or threatened. These species are protected by regulations that prohibit hunting and control commerce. The Commonwealth of Virginia must adhere to the Federal regulations for threatened and endangered species, but also has the authority to modify the regulations to include additional species and classify them as State endangered or threatened. The capture, killing, transportation, or selling of a wildlife species classified as threatened or endangered is forbidden.

Under the Endangered Species Act, no Federally funded action or permit can in any way threaten the continued existence of a listed species. Wallops Flight Facility is obligated to protect State and Federally listed species, should a listed species be identified on the facility. The following definitions of endangered or threatened species apply to both the Federal and State regulations, and are included in Virginia regulations.

Endangered species - any species that is in danger of extinction throughout all or a significant portion of its range.

Threatened species - any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

### 4.2.2.3 Threatened or Endangered Floral and Faunal Species

The following Federal and State agencies oversee the classification and regulations of the endangered and threatened floral and faunal species at Wallops Flight Facility:

- United States Department of the Interior, Fish and Wildlife Service
- Commonwealth of Virginia Department of Agriculture and Consumer Services
- Commonwealth of Virginia Department of Game and Inland Fisheries
- Commonwealth of Virginia Department of Conservation and Recreation, Division of Natural Heritage

The following species are considered threatened or endangered in the Wallops Flight Facility area as of August 1999. The list is based on the Federal and State Endangered and Threatened Species in Virginia listing from the Commonwealth of Virginia Department of Game and Inland Fisheries.

**TABLE 4-35**
**STATUS OF THREATENED OR ENDANGERED SPECIES**
**AUGUST 1999**

| SCIENTIFIC NAME | COMMON NAME | STATUS |
|---|---|---|
| **Reptiles** | | |
| Caretta caretta | Loggerhead Sea Turtle | Federal Threatened |
| Chelonia mydas | Atlantic Green Sea Turtle | Federal Threatened |
| Dermochelys coriaces | Leatherback Sea Turtle | Federal Endangered |
| Eretmochelys imbricata | Hawksbill Sea Turtle | Federal Endangered |
| Lepidochelys kempi | Kemp's Ridley Sea Turtle | Federal Endangered |
| **Birds** | | |
| Bartramia longicauda | Upland Sandpiper | State Threatened |
| Charadrius melodus | Piping Plover | Federal Endangered |
| Charadrius wilsonia | Wilson's Plover | State Endangered |
| Falco peregrinus | Peregrine Falcon | State Endangered |
| Haliaeetus leucocphalus | Bald Eagle | Federal Threatened |
| Sterna nilotica | Gull-billed tern | State Threatened |
| **Marine Mammals** | | |
| Balaenoptera borealis | Sei Whale | Federal Endangered |
| Balaenoptera musculus | Blue Whale | Federal Endangered |
| Baleanoptera physalus | Fin Whale | Federal Endangered |
| Eubalaena glacialis | Northern Right Whale | Federal Endangered |
| Megaptera novaeangliae | Humpback Whale | Federal Endangered |
| Physeter catodon | Sperm Whale | Federal Endangered |

This list of species is subject to change. In the future, there may be either additions or deletions of species on this list or the status of the species currently on the list may change. The United States Fish and Wildlife Service determines any additions, deletions, or status changes for the

Federally classified threatened or endangered species. The Commonwealth of Virginia has the authority to add species to the list, or delete or change the status of State threatened or endangered species.

No Federal or State endangered or threatened floral species have been identified at Wallops Flight Facility. This conclusion is based on correspondences with the Division of Natural Heritage and the Department of Agriculture and Consumer Services. The following list of rare flora was provided by the Division of Natural Heritage.

**TABLE 4-36**
**RARE FLORA AT Wallops Island, JANUARY 1992**

| SCIENTIFIC NAME | COMMON NAME | STATUS |
|---|---|---|
| Carex staminea | Straw Sedge | Very Rare |
| Elocharis rostellata | Beaked Spikerush | Extremely Rare |
| Eriocaulon decangulare | Ten-angle Pipewort | Extremely Rare |
| Juncus megacephalus | Big-head Rush | Very Rare |
| Plantago maritima | Seaside Plantain | Extremely Rare |
| Sclerolepis uniflora | One-flower Sclerolepis | Extremely Rare |

Federal or State threatened and endangered birds may be found at various locations on Wallops Flight Facility. Upland sandpiper may occur in large grassy areas such as those adjacent to the runway on the Main Base during migratory season. Gull-billed tern, piping plover and Wilson's plover may nest on beach or mud flats on Wallops Island. A resident pair of peregrine falcons nests on a hacking tower on the northwest side of Wallops Island. Migrating peregrine falcons occur along the Wallops Island beach during fall migration. An active bald eagle nest exists on the northern border of the Wallops Flight Facility Main Base.

The Division of Natural Heritage establishes protection priorities for plant and animal species. The ranking system used by the Division of Natural Heritage is based on the number of populations or occurrences of the species and the quality of life within those populations or occurrences. The status of "very rare" usually means between 5 and 20 populations or occurrences, while the status of "extremely rare" indicates less than 5 populations or occurrences. There is no legal penalty under Federal or State law associated with species classified as very rare or extremely rare (Reference 27).

### 4.2.2.4 Management Practices

The Endangered Species Act defines critical habitat as a geographical area that is essential to the survival and recovery of the species. Wallops Island has a geographical area that is essential to the piping plover's survival and recovery. Wilson's plover is known to breed on the southern end of Wallops Island. The southern end of Wallops Island has been closed to vehicle or human entry during the plover's nesting season since 1986. Chincoteague National Wildlife Refuge and the Commonwealth of Virginia Department of Game and Inland Fisheries biologists monitor plover nesting activities and provide advice to Wallops Flight Facility on protection and management of the plover. Other species, in addition to the piping plover, have benefited from the protected habitat. The Wilson's plover and gull-billed terns have been sighted in the critical habitat area (Reference 24).

Commonwealth of Virginia Department of Game and Inland Fisheries conducted research and management procedures on nesting Wilson's plovers on the southern end of Wallops Island using wire fenced predator enclosures. Red foxes and raccoons are the primary predators to the eggs. The predator enclosures were the first to be used on Wilson's plovers. As a result of this research, no eggs were lost due to predators.

The following proposed piping plover critical habitat locations on Wallops Island are from the Draft Federal Register Proposed Rule, Endangered and Threatened Wildlife and Plants: Proposed Designation of Critical Habitat for the Atlantic Coast Piping Plover (Reference 34). Refer to Figure 4-16 for the approximate locations of the proposed critical habitat area for piping plovers. The proposed critical habitat for the piping plover on Wallops Island includes all the lands above the mean low water and the 10-foot (3 meters) contour within the following areas:

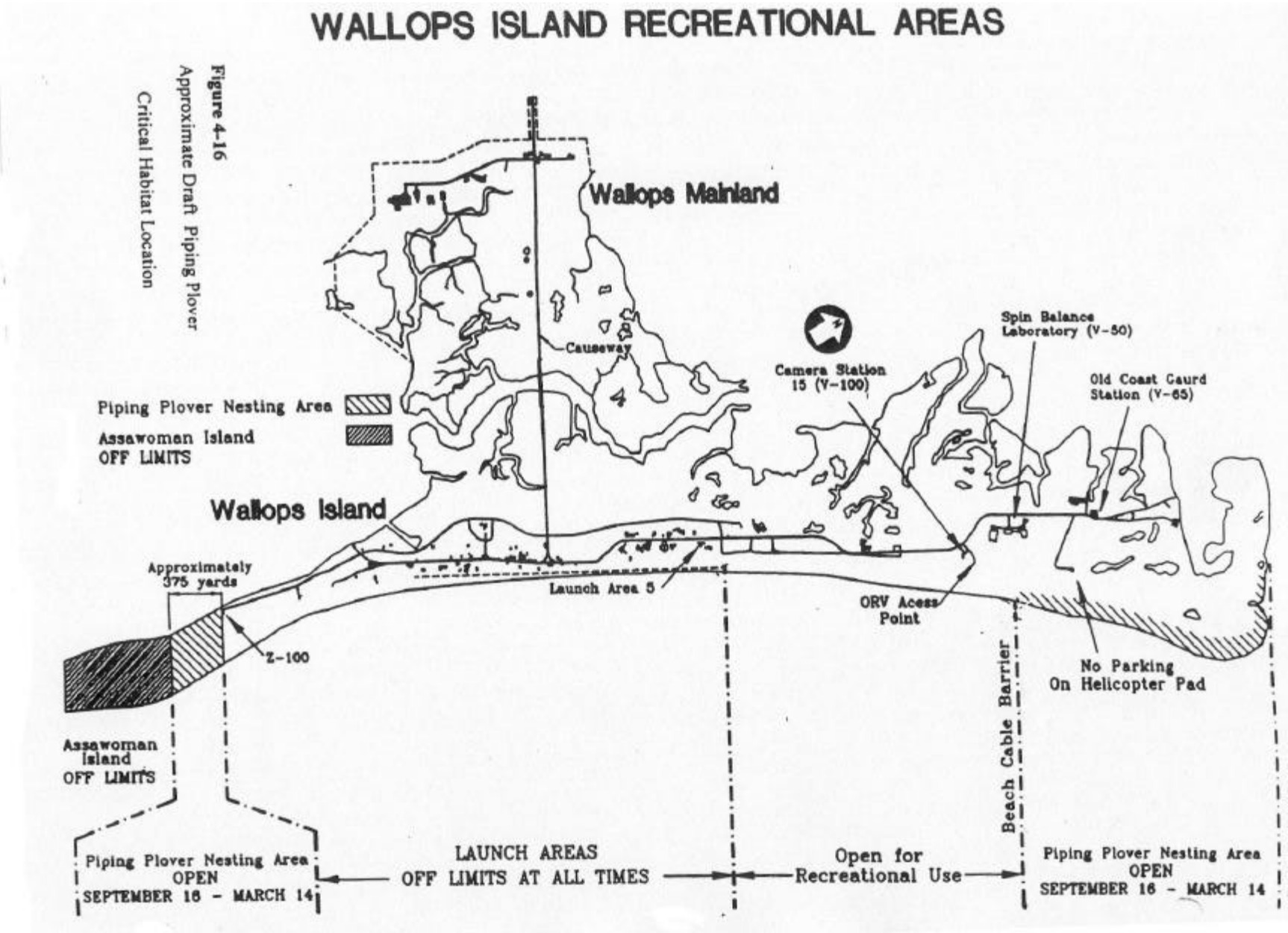
- The northern area commences at a point on the northernmost end of the jeep trail at 38°53'09", thence running due north to mean low water in Taylors Narrows, thence clockwise to mean low water into Chincoteague Sound, thence southwesterly at mean low water to a point 37°52'33"N, then due west to the eastern end of the jeep trail, thence northwest to the point of beginning (Reference 34).

- The southern area includes the area south of 37°49'22"N, 75°29'56"W and 37°49'17"N and the mean low water of the Atlantic Ocean (Reference 34).

The critical habitat areas will not limit or affect the suborbital projects. Sounding rockets have little effect on the piping plover critical habitat area. Predators and recreational use affect the critical habitat more than the sounding rockets program. Predator management and limited recreational use during nesting season might be required to prevent adverse modification of the plover habitat (Reference 87).

Low-level helicopter flights may adversely modify the plover critical habitat. Two helicopter flight corridors provide access to a heliport located in the northern portion of Wallops Island. These helicopter corridors are not within the proposed critical habitat area. The flight corridors were chosen to minimize the risk to the public based on the unknown hazards of the flights. The helicopter flights are usually above altitudes of 100 feet (30.5 meters) and are flown only 5 to 10 days during breeding season.

Two State Endangered Peregrine Falcons have nested in the hacking tower for the past few years. During several breeding seasons eggs were laid but did not hatch (Reference 72).


WALLOPS ISLAND RECREATIONAL AREAS
Figure 4-16
Approximate Draft Piping Plover
Critical Habitat Location
Wallops Mainland
Causeway
Camera Station
15 (V-100)
Spin Balance
Laboratory (V-50)
Old Coast Gaurd
Station (V-65)
Piping Plover Nesting Area
Assawoman Island
OFF LIMITS
Wallops Island
Approximately
375 yards
Launch Area 5
ORV Acess
Point
Z-100
No Parking
On Helicopter Pad
Beach Cable Barrier
Assawoman
Island
OFF LIMITS
Piping Plover Nesting Area
OPEN
SEPTEMBER 16 - MARCH 14
LAUNCH AREAS
OFF LIMITS AT ALL TIMES
Open for
Recreational Use
Piping Plover Nesting Area
OPEN
SEPTEMBER 16 - MARCH 14

## 4.3 SOCIAL AND ECONOMIC FACTORS

### 4.3.1 Population, Employment, and Economic Trends

#### 4.3.1.1 Population

The study area for Wallops Flight Facility includes Accomack and Northampton Counties in Virginia, and Somerset, Worcester, and Wicomico Counties in Maryland. Wallops Flight Facility is located in Accomack County, Virginia, which is the northermost of the two Virginia counties on the south end of the Delmarva Peninsula. On the southern tip of the Delmarva Peninsula, Virginia's Accomack and Northampton counties separate the Chesapeake Bay from the Atlantic Ocean. The numbers of employees residing in Virginia, including government and support contractors, are 615; NOAA 65; and Navy 285. Table 4-37 lists geographical distribution by county of NASA and Navy employees.

**TABLE 4-37**
**GEOGRAPHICAL DISTRIBUTION BY COUNTY**

| COUNTY | NASA EMPLOYEES | NAVY EMPLOYEES |
|---|---|---|
| Accomack | 617 | 297 |
| Northampton | 18 | 3 |
| Somerset | 46 | 16 |
| Wicomico | 100 | 38 |
| Worcester | 177 | 57 |
| Other | 9 | 2 |

Chincoteague Island, Virginia is approximately 5 miles east of the Main Base. It is the largest densely populated area near Wallops Flight Facility, with a resident population of almost 3,400 people. Area populations are seasonal and fluctuate. During the summer months, the population increases due to tourism and vacationers who visit the nature reserve and beaches of Assateague Island. Daily populations often reach up to 15,000 in the summer months. Special events, like the carnival and the pony roundup/auction, sponsored by the Chincoteague Volunteer Fire Department in July, more than double the daily population.

Wallops Flight Facility is located in a rural area, and year-round densities of neighboring areas are low. Table 4-38 shows the population and density of Accomack and neighboring counties. Table 4-39 lists the 1991 population of towns in Accomack and Northampton Counties.

#### 4.3.1.2 Economic history

NASA is one of the largest employers on Virginia's Eastern Shore. The southern portion of the Delmarva Peninsula is a rural, agricultural region with farming, forestry, and commercial fishing being the major employment industries. The NASA budget for Wallops Flight Facility for FY 1999 was 130.1 million dollars. Table 4-40 list the economic impact of Wallops Flight Facility.

**TABLE 4-38**
**POPULATION AND DENSITY**

| COUNTY | POPULATION | LAND AREA (Sq. Mi.) | DENSITY (People/Sq. Mi.) |
|---|---|---|---|
| Accomack, VA | 32,500 | 476 | 68.3 |
| Northampton, VA | 12,900 | 226 | 57.1 |
| Somerset, MD | 23,440 | 338 | 69.3 |
| Wicomico, MD | 79,250 | 379 | 209.1 |
| Worcester, MD | 39,950 | 475 | 84.1 |

(Reference 53)

**TABLE 4-39**
**POPULATION - WALLOPS FLIGHT FACILITY VICINITY**

| LOCATION | POPULATION | HOUSING UNITS |
|---|---|---|
| Accomack County | 32,500 | 15,840 |
| Accomac Town | 464 | 205 |
| Belle Haven Town | 530 | 245 |
| Bloxom Town | 363 | 175 |
| Chincoteague Town | 3,354 | 3,500 |
| Melfa Town | 430 | 191 |
| Onancock Town | 1,205 | 705 |
| Onley Town | 538 | 276 |
| Parksley Town | 776 | 393 |
| Saxis Town | 375 | 192 |
| Tangier Town | 672 | 277 |
| Northampton County | 12,900 | 6,183 |
| Cape Charles Town | 1,321 | 689 |
| Cheriton Town | 472 | 246 |
| Exmore Town | 1,109 | 528 |
| Nassawadox Town | 556 | 227 |

**TABLE 4-40**
**ECONOMIC IMPACT OF WALLOPS FLIGHT FACILITY**

ALL FIGURES IN MILLIONS OF DOLLARS (FY 1999)

| | NASA | NAVY | NOAA | TOTAL WALLOPS |
|---|---|---|---|---|
| Total Budget | 130.1 | 19.6 | 7.0 | 155.2 |
| Total Economic Impact | 55 | 14 | 7 | 76 |

#### 4.3.1.3 Employment/Unemployment

NASA employed 233 permanent, full-time, civil service personnel at Wallops Flight Facility in 1999. Navy and NOAA personnel are also working at the facility. At NASA, there are approximately 944 employed personnel including the civil service employees and contractor employees. Table 4-41 illustrates the number of full-time Wallops Flight Facility employees from 1982 through 1999. Approximately 5 percent of the total work force in Accomack and Northampton Counties.

Wallops Flight Facility is the third largest employer in Accomack County. Table 4-42 lists the employee distribution by employment category for Wallops Flight Facility. AEGIS Combat System Center, Naval Surface Warfare Center, and Naval Air Warfare Center employed, respectively, 346, 21, and 5 military, civilian, and contractor personnel in fiscal year 1998. Table 4-43 lists the manpower changes between 1981 and 1992. Table 4-44 list the total Wallops Flight Facility labor force including NASA civil service 233 employees, NASA support contractors 711 employees, Navy 372 employees, and NOAA 99 employees.

Employment in Accomack and Northampton Counties fluctuates seasonally, throughout the agricultural and seafood industries. During the months of June to October, the greatest number of residents are employed in the civilian labor force. These months also result in the lowest rates of unemployment, usually between 6 and 4 percent, respectively. (Reference 30).

**TABLE 4-41**
**FULL TIME WALLOPS FLIGHT FACILITY EMPLOYEES**

| FY | NASA CIVIL SERVICE | NASA CONTRACTORS |
|---|---|---|
| 1982 | 354 | 353 |
| 1983 | 385 | 385 |
| 1984 | 362 | 405 |
| 1985 | 359 | 441 |
| 1986 | 351 | 536 |
| 1987 | 368 | 560 |
| 1988 | 375 | 709 |
| 1989 | 380 | 725 |
| 1990 | * | 766 |
| 1991 | 361 | 817 |
| 1992 | 391 | 791 |
| 1993 | 363 | * |
| 1994 | 355 | * |
| 1995 | 348 | 588 |
| 1996 | 303 | * |
| 1997 | 280 | 577 |
| 1998 | 250 | 617 |
| 1999 | 233 | 711 |

(Reference 53)* Data not available

**TABLE 4-42**
**EMPLOYEE DISTRIBUTION**

| | EMPLOYEES (%) | |
|---|---|---|
| CATEGORY | CIVIL SERVICE | CONTRACTOR |
| Scientific/Engineering | 39 | 20 |
| Professional/Administrative | 19 | 20 |
| Technical | 30 | 34 |
| Secretarial/Clerical | 12 | 4 |
| Crafts/Trades | 0 | 22 |
| TOTAL | 100 | 100 |

**TABLE 4-43**
**MANPOWER CHANGES AT WALLOPS FLIGHT FACILITY**
**(INCLUDING GOVERNMENT AND SUPPORT CONTRACTORS)**

| FACILITY | 1981 | 1999 |
|---|---|---|
| NASA | 732 | 963 |
| NAVY | 31 | 387 |
| NOAA | 105 | 99 |

**TABLE 4-44**
**TOTAL WALLOPS FLIGHT FACILITY LABOR FORCE**

| EMPLOYER | EMPLOYEES |
|---|---|
| NASA Civil Service | 252 |
| NASA Support Contractors | 711 |
| NAVY | 387 |
| NOAA | 99 |
| TOTAL | 1,449 |

Virginia has a right-to-work law, and no union work stoppages have occurred within the last 5 years. The unemployment rate as of April 1999 was 3.4 percent for Northampton and 6.0 percent for Accomack Counties, with a combined unemployment rate of 5.3 percent. The civilian labor force in these counties totaled 19,594 (Reference 7). Table 4-45 lists the employee distribution by employment category for Accomack and Northampton Counties as of the third quarter of 1998.

**TABLE 4-45**
**COUNTY EMPLOYEE DISTRIBUTION**

| CATEGORY | ACCOMACK EMPLOYEES (%) | NORTHAMPTON EMPLOYEES (%) |
|---|---|---|
| Agricultural | 17 | 25 |
| Construction | 4 | 2 |
| Manufacturing | 25 | 7 |
| Transportation | 3 | 1 |
| Trade | 17 | 20 |
| Finance, Insurance, Real Estate | 2 | 1 |
| Services | 16 | 23 |
| Government | 16 | 21 |

(Reference 53)

#### 4.3.1.4 Income

NASA employment categories at Wallops Flight Facility consist largely of managerial, professional, and technical disciplines. The mean salary of NASA civil service employees at Wallops Flight Facility for FY 1998 was $55,172 and $41,423 for FY 1992. The NASA Wallops Flight Facility mean annual income exceeds the mean family income of $27,632 for Accomack County and $26,300 Northampton County in 1998. Due to the wide gap between salaries of NASA employees at Wallops Flight Facility and most Accomack County residents, the facility contributes significantly to the local economy. Table 4-46 groups the NASA civil service employees at Wallops Flight Facility by income.

**TABLE 4-46**
**CIVIL SERVICE EMPLOYEE INCOME**

| SALARY IN $ | % EMPLOYEES |
|---|---|
| Under 20,000 | 0 |
| 20,000-25,000 | 0.5 |
| 25,000-30,000 | 8.0 |
| 30,000-35,000 | 5.5 |
| 35,000-40,000 | 5.5 |
| 40,000-45,000 | 4.5 |
| over 45,000 | 76.0 |

(Reference 53)

#### 4.3.1.5 Community Cohesion

NASA provides many employee activities and facilities through the Wallops Employee Morale Association and the Morale Activities Committee organizations. These organizations encourage the social, athletic, educational, and cultural interests of members through organized activities and functions at Wallops Flight Facility.

All active and retired civil service employees, contractor employees, and tenant employees are eligible as members of Wallops Employee Morale Association. The immediate families and guests of these employees may also participate in activities and clubs sponsored by the Morale Activities Committee. The organization consists of almost 20 clubs, including aerobics, flying, hunting and fishing, karate, skiing, softball, table tennis, and volleyball clubs. Other sponsored facilities, functions, and services include basketball and tennis courts, canoe rentals, a gymnasium, softball fields, dances, dinners, picnics, and the Wallops Blood Bank.

Several programs assist in providing general community cohesion between the Wallops Flight Facility population and surrounding communities. Special programs for schools and civic groups may be arranged through the Wallops Visitor Center. These programs vary from tours of the facility to lectures and special films. Also available at the Wallops Visitor Center is the use of the Education Resource Center. This service allows educators from the area to obtain publications and videotapes on topics including planets, astronomy, the space shuttles, life in space, careers, and the environment. Videotapes are also available for copying by the educator for use in the classrooms.

### 4.3.2 Land Values/Tax Levels

#### 4.3.2.1 Land Values

The value of parcels of land in Accomack County varies greatly depending on proximity to water. The cost of 1 to 3-acre parcels of land not located on water can range from approximately $10,000 to $18,000. Building parcels on the water range from approximately $70,000 to $150,000 for a 3-acre site (Reference 36). Present land uses in Accomack County vary from largely woodland and cropland to salt water bays and creeks. Table 4-47 characterizes land in Accomack and Northampton County by use.

**TABLE 4-47**
**LAND USE IN ACCOMACK AND NORTHAMPTON COUNTIES**

| USE | APPROXIMATE ACREAGE | PERCENT |
|---|---|---|
| Woodland | 109,664 | 36.0 |
| Cropland | 94,887 | 31.1 |
| Saltwater Bays and Creeks | 46,453 | 15.2 |
| Bayside Tidal Marsh | 23,918 | 7.9 |
| Residential | 15,063 | 5.0 |
| Assateague National Seashore | 8,300 | 2.7 |
| Coastal Beach | 2,500 | 0.8 |
| Wallops Flight Facility | 1,559 | 0.5 |
| Industrial | 895 | 0.3 |
| Institutional | 840 | 0.3 |
| Commercial | 529 | 0.2 |
| TOTAL | 304,608 | 100.0 |

(Reference 7)

For future land use purposes, Wallops Flight Facility is located within a region designated as the Atlantic District. The facility has been zoned in the proposed land use category as an industrial district. This zoning includes Wallops Island, the Mainland, and the Main Base of Wallops Flight Facility.

Proposed land use categories have been developed in order to create orderly development with compatible land uses in Accomack County. The industrial district is provided to allow for certain industries of a clean, efficient, and environmentally friendly nature to locate in Accomack County. However, these types of industries would be recommended to locate in the Accomack County Industrial Park. Examples of the uses allowed in this district would include light manufacturing, research laboratories, food preparation and processing, bottling plants, electronic plants, metal fabrication, garment manufacturing, inter-modal transportation of goods, warehousing, agricultural facilities, and public passenger station with appropriate parking and other facilities (Reference 3).

Most of the areas surrounding Wallops Flight Facility are zoned in the Residential and Agriculture proposed land use categories. The primary uses allowed in the residential districts would include single-family dwellings, townhouses, multi-family structures, churches, parks, and playgrounds.

The purpose of the Agricultural District is to promote agricultural lands for agricultural fractions and not for large-scale residential development. Types of primary uses recommended for this zone include all agricultural activities and horticulture uses, such as orchards, vineyards, nurseries, raising and grazing of livestock and swine, forestry, saw mills, game preserves, fish hatcheries, and fish ponds. Residential uses would be limited to dwelling or lodging units for persons owning or employed full-time on the premises (Reference 3).

#### 4.3.2.2 Tax Levels

Table 4-48 presents the property tax rates for Accomack and Northampton Counties. Both counties implement tax relief plans for handicapped and elderly persons. State taxes on corporate income, individual income, and retail sales are 6, 2 to 5.75, and 4.5 percent, respectively. Incorporated towns in Virginia also have personal property and real estate taxes. Persons living in an incorporated town pay both County and town taxes. The Town of Chincoteague also has a 4 percent food tax and a 2 percent transient occupancy tax.

### 4.3.3 Institutional Resources

#### 4.3.3.1 Housing Characteristics

Navy family housing facilities on Wallops Flight Facility are currently partially occupied with a waiting list. There are now 134 Navy personnel and 50 USCG personnel living in Wallops Flight Facility housing facilities, which include 48 family housing units, 16 Bachelor Officer Quarters units, 80 Bachelor Enlisted Quarters units and 25 USCG houses. NASA maintains several short-term dormitories in Buildings F-4 and F-5 on the Main Base for employees participating in training programs and visiting scientists.

The nearest area with an ample supply of available housing rentals is Pocomoke City, in Worcester County, Maryland, approximately 15 miles northwest of the Main Base. Limited housing is also available in the immediate vicinity such as on Chincoteague Island. Housing on Chincoteague Island consists mostly of older single-family homes, and includes vacation homes that are usually available only for winter rentals. Housing costs in the Chincoteague area are high due to the influx of tourists, which limits the availability of housing for military personnel and results in a high demand for Navy housing at Wallops Flight Facility (Reference 89).

**TABLE 4-48**
**1998 TAX RATES**

| ACCOMACK COUNTY | NORTHAMPTON COUNTY | |
|---|---|---|
| Real Property | | |
| Rate/$100 (Actual Value) | 0.66 – 0.82 | 0.68 |
| Assessment Ratio | 100% | 100% |
| Personal Property | | |
| Rate/$100 (Actual Value) | 3.13 – 3.26 | 4.10 |
| Assessment Ratio | 100% | 100% |
| Local Non-Property | | |
| Machinery-Equipment | 3.13 – 3.26 | 2.25 |
| Assessment Ratio | 100% | 100% |

(Reference 30)

The housing limitations would be alleviated somewhat with the development of new personnel facilities now being proposed for the Main Base. The proposed action consists of the multi-phased construction of personnel and mission support facilities on a 67.6 acre parcel on the Main Base near the entrance to Wallops Flight Facility. The housing increases include 31 Bachelor Officer Quarters units and 38 additional single-family housing units. Phase one, which includes 10 duplex units for 20 families, was completed in Spring of 1999.

#### 4.3.3.2 Health and Social Services

Health Facilities

Three local emergency health services are located in the vicinity of Wallops Flight Facility. Wallops Flight Facility has its own health unit with a full-time nursing staff and a part-time physician to provide first aid and immediate assistance to patients in emergency situations. The Health Unit operates from 8:00 a.m. - 4:30 p.m. After-hours emergency medical care is provided by Emergency Medical Services staff of the Wallops Flight Facility Fire Department. The Chincoteague Medical Center on Chincoteague Island and the Atlantic Medical Center in Oak Hall, Virginia, also provide emergency assistance, and are both located within 5 miles of Wallops Flight Facility area. Four hospitals are also located in the region, all within 40 miles of Wallops Flight Facility. These hospitals include the following:

- Atlantic General Hospital in Berlin, Maryland
- McCready Memorial Hospital in Crisfield, Maryland
- Peninsula Regional Medical Center in Salisbury, Maryland
- Shore Memorial Hospital in Nassawadox, Virginia

The Peninsula Regional Medical Center serves as the regional trauma center for the Delmarva Peninsula. If additional trauma care is needed, Sentara Norfolk General Hospital is 19 minutes away (by helicopter) from Shore Memorial Hospital in Nassawadox. Accomack and Northampton County Health Departments offer clinical services. Worcester, Somerset, and Wicomico Counties also have health departments. Five nursing homes on Virginia's Eastern Shore and eight nursing homes on Maryland's Lower Eastern Shore are available to the community.

Library Resources

The GSFC branch library at Wallops Flight Facility contains over 21,000 volumes. The library has a large selection of technical, scientific, and managerial resources, along with numerous computer hardware and software titles. Other library resources available to the public include the Eastern Shore Public Library in Accomac, with more than 65,000 volumes (Reference 53). Libraries in Maryland include Worcester County Libraries (Berlin, Ocean City, Pocomoke City, and Snow Hill Branches), Wicomico County Library (Salisbury), and Somerset County Library System (Corbin Memorial Library, Ewell Branch, and Princess Anne Public Library).

Utilities

NASA operates and maintains the existing utilities infrastructure at Wallops Flight Facility. Electric and fuel oil utility sources are described in detail in Section 4.1.2, Energy Usage. Potable water and wastewater treatment services are described in detail in Section 4.1.3, Water Resources. Telecommunication services are provided by Bell Atlantic Telephone Company of Virginia. The ROLM telephone system and FTS2000 long-distance communications are used at Wallops Flight Facility. Long distance services at Wallops Flight Facility are provided by AT&T.

Fire and Police Protection

Wallops Flight Facility maintains a security force that is responsible for the internal security of the base. The force provides 24-hour per day protection services for 6000 acres of real estate, 513 buildings and structures, and approximately 1,600 employees and 11,000 visitors per year (Reference 49). There are two entrance gates to the Wallops Flight Facility that control and monitor the daily employee and visitor traffic. Other services provided by the security force are security patrols, employee and visitor identification, mail delivery, after-hours security checks, and police services.

Police protection for the surrounding areas is supplied by town, county, and state personnel. The Commonwealth of Virginia's police force employs 18 officers in the area, while the Accomack County Sheriff's Office has approximately 23 officers. The Town of Chincoteague has its own police force consisting of 9 officers.

Wallops Flight Facility maintains onsite 24-hour fire company personnel who provide fire protection services for facility buildings, and are trained in crash rescue and fire suppression for the airfield. The fire company personnel are housed in two buildings on the facility, one on Wallops Island and one on the Main Base. Wallops Flight Facility Fire Department has a Mutual Aid Agreement with the Accomack-Northampton Fireman's Association for any outside assistance needed at the facility. The local fire companies nearest Wallops Flight Facility are in Atlantic, Chincoteague, and New Church.

Solid Waste

NASA has a contract with Shore Disposal, a private contractor, to collect and dispose of all non-hazardous solid wastes generated at Wallops Flight Facility. Hazardous wastes generated on site are disposed of by NASA contractors (see Section 4.1.8.2.2, Hazardous Waste). Refuse is disposed of in sanitary landfills operated by each county.

Communications

Three regional Virginia-based radio stations, three FM and one AM, service Accomack and Northampton Counties. Numerous Maryland radio stations and two television stations also serve the Wallops Flight Facility area. Daily newspapers available to the community include the *Norfolk Virginian Pilot*, the *Salisbury Daily Times*, and other metropolitan dailies. The weekly *Eastern Shore Post* and the biweekly *Eastern Shore News* serve as the main sources of local news for the Eastern Shore of Virginia. Numerous weekly local and community newspapers are also available. Falcon Cable, Comcast Cable Communications, and United Artists Cable provide cable service to local residents. The United States Postal Service, United Parcel Service, Federal Express, and Airborne Express perform daily delivery and pickup services at Wallops Flight Facility (Reference 30).

Retail/Commercial

Existing shops at Wallops Flight Facility include the Wallops Exchange, the cafeteria, and the Wallops Visitor Center gift shop. The Navy constructed a Navy Exchange in 1996 that includes a retail store, cafeteria, service outlets, exchange warehouse, and a clothing/uniform shop.

The Eastern Shore of Virginia features two centrally located major shopping centers in Onley (Accomack County), and one in Northampton County, consisting of numerous department stores and specialty shops. Smaller shopping facilities featuring regional specialty foods and gifts are available in towns throughout the county. Many Accomack County residents also frequent the shopping centers in Pocomoke City, Maryland, and Salisbury, Maryland.

Religions

More than 100 Protestant and 3 Catholic churches exist throughout Accomack County. No synagogues or mosques currently exist in the county. Approximately 100 Protestant and 5 Catholic churches, and one synagogue exist in the combined areas of Somerset and Worcester Counties.

#### 4.3.3.3 Educational Resources

Accomack County schools have an enrollment of approximately 5,425 students, while the Northampton County school system consists of 2,425 students. The majority of Navy personnel school-age children are enrolled in Accomack County schools, while many others are in schools in Worcester and Somerset Counties in Maryland. Table 4-49 indicates the composition of Accomack County and Northampton County school systems. Northampton County consolidated its elementary schools into two new schools in 1993. Accomack County built 4 new elementary schools in 1998 and completed renovations on 2 other elementary schools in 1999. Maryland schools within the region include 13 in Wicomico County, 10 in Worcester County and 9 in Somerset County.

**TABLE 4-49**
**COMPOSITION OF ACCOMACK AND NORTHAMPTON COUNTY SCHOOL SYSTEMS**

| | ACCOMACK COUNTY | | |
|---|---|---|---|
| | NUMBER OF SCHOOLS | NUMBER OF TEACHERS | NUMBER ENROLLED |
| Elementary (K-5) | 5 | 123 | 2552 |
| Middle (6-8) | 4 | 105 | 1208 |
| High School (9-12) | 3 | 111 | 1511 |
| Tangier Combined School (K-12) | 1 | 18 | 114 |
| Total | 3 | 357 | 5385 |

(Reference 89)

| | NORTHAMPTON COUNTY | | |
|---|---|---|---|
| | NUMBER OF SCHOOLS | NUMBER OF TEACHERS | NUMBER ENROLLED |
| Elementary (K-5) | 2 | 85 | 1100 |
| Middle (6-8) | 1 | 43 | 575 |
| High School (9-12) | 1 | 57 | 750 |
| Total | 4 | 185 | 2425 |

(Reference 30)

Two private schools are located in the region. In Virginia, the Broadwater Academy is a PreK-12 coeducational preparatory school in Exmore. (Reference 29). In Maryland, Holly Grove Christian school is located in Westover.

For higher education, the Eastern Shore Community College in Melfa, Virginia offers courses in several disciplines. The Eastern Shore Community College is a 2-year college with an enrollment of almost 600 students. The Marine Science Consortium is located adjacent to Wallops Flight Facility and uses the Wallops Flight Facility boat basin, and beaches and marshes for field trips. In addition, Virginia Institute of Marine Sciences operates a shellfish culture

facility at Wachapreague, Virginia. Other neighboring facilities for post secondary education include Wor-Wic Community College, a 2-year coeducational institution, and Salisbury State University, a 4-year college, both located in Salisbury, Maryland. Another four-year academic facility is the University of Maryland Eastern Shore located in Princess Anne, Maryland, with a total student enrollment of more than 1500 students (Reference 53).

#### 4.3.3.5 Transportation Systems

The Eastern Shore of Virginia is connected to the rest of the state by the double span of the 17.6 mile long Chesapeake Bay Bridge-Tunnel. The primary north-south route that spans the Delmarva Peninsula is U.S. Route 13, a four-lane divided highway. Local traffic travels by arteries branching off of U.S. Route 13. Access to Wallops Flight Facility is provided by State Route 175 to State Route 178, a two-lane secondary road. Many Wallops Flight Facility employees carpool to and from the facility due to the great distances from their residences. The majority of civil service and contractor employees commute to and from Accomack County, Virginia, or Worcester County, Maryland, a daily round-trip distance of approximately 50-60 miles. Traffic in the region of Wallops Flight Facility varies with the seasons. During the winter and early spring, traffic is minimal, while during the summer and early fall, traffic increases due to tourism (Reference 53).

Commercial air service is provided through the Norfolk International Airport and the Salisbury Regional Airport, about 90 miles to the south and 40 miles to the north of Wallops Flight Facility, respectively. Air service is also available through the Accomack County Airport in Melfa, which usually provides flights only during daylight hours. Surface transportation from the airports to the facility is by private rentals, government vehicles, and commercial bus or taxi. Ground transportation to the Salisbury Airport is occasionally provided by a Wallops Flight Facility Shuttle Bus for NASA employees only. Chartered and private aircraft, both piston and jet type, may land, with the proper clearance, at Wallops Flight Facility Airport for business purposes. Air-freight services are available from the Salisbury Regional Airport and are provided by U.S. Air and Butler Air Freight.

Rail freight service is provided to the peninsula by the Eastern Shore Railroad. No rail passenger service is available to Wallops Flight Facility. Eleven motor freight carriers that serve the eastern United States are authorized to provide service to the Accomack-Northampton District.

Ocean cargo shipments are off-loaded at the Port of Baltimore (Maryland) or Cape Charles (Virginia) and then transferred to commercial trucks or rail for transportation to Wallops Flight Facility. There are numerous small harbors located throughout Accomack and Northampton Counties, which are used primarily for commercial or recreational fishing and boating (Reference 7).

### 4.3.4 Tourism and Recreational Opportunities

For most of the year, the NASA Wallops Visitor Center is open free of charge to the public Thursday through Monday, from 10 a.m. to 4 p.m. The Wallops Visitor Center is open 7 days a week from July 4 through Labor Day.

A variety of educational exhibits and space displays are accessible through the Wallops Visitor Center. Some of these displays include a Moon rock, scale models of space probes, satellites, and aircraft, displays of current and future NASA projects, and full-scale aircraft and rockets. Other special activities sponsored by the Wallops Visitor Center include films on space and aeronautics as well as model rocket demonstrations.

The Wallops Visitor Center is accessible to individuals with disabilities. All buildings and facilities are wheelchair accessible, and interpreters are available for the hearing impaired for all tours and events.

Many activities and facilities are offered to Wallops Flight Facility employees and their families through the Wallops Employee Morale Association. There are numerous clubs and recreational facilities used by employees throughout the year. The Wallops Employee Morale Association is discussed in more detail in Section 4.3.1.5, Community Cohesion.

Many tourists and vacationers visit the Eastern Shore throughout the late spring, summer, and early fall. Regional attractions include the Assateague Island National Seashore, which has 26 miles of undeveloped shoreline in two states (Virginia and Maryland), and the Chincoteague National Wildlife Refuge, which is home to many species of animals. Water sports, including sailing, swimming, fishing and crabbing, are available for recreation. Hunting during the winter season offers plentiful game including: dove, quail, deer, fox, and many types of geese and ducks (Reference 29).

Accomack and Northampton Counties also offer an assortment of recreational opportunities. Two county park facilities support many recreation programs including softball, volleyball, and basketball leagues, as well as youth football, soccer and little league baseball programs (Parks and Recreation). Tennis courts, ball fields, public beaches, a roller rink, and indoor movie theaters also provide sources of recreation and entertainment throughout the counties.

Many of the towns in the area are home to historic sites and landmarks. The annual Garden Tour held as a one-day event at the end of April showcases many of these attractions at various locations throughout the Eastern Shore.

### 4.3.5 Areas of Unique Significance

Although not officially recognized as an historic landmark, Wallops Flight Facility has been established as a significant contributor to area history due to its contributions in rocketry, aircraft design, and manned space flights over the years. A preliminary architectural and archaeological resources study was performed by 3D Environmental Services, Inc. for Wallops Flight Facility. The findings can be found in the published report entitled *Architectural and Archaeological Cultural Resources Inventory for NASA's Wallops Flight Facility.* Included in this report is an Architectural and Archaeological Cultural Resources Inventory. The interim report provides an historical and cultural overview, and includes any known cultural resources (see Section 4.3.6, Cultural Environment). On the Eastern Shore, more than two dozen buildings and structures have been placed on the National Register of Historic Places and listed as Virginia Historic Landmarks, often attracting visitors to the area.

Other areas of unique significance on the Eastern Shore include the Assateague Island National Seashore and the Chincoteague National Wildlife Refuge. Chincoteague Island is the site of the Chincoteague Pony Penning and Auction held annually in July.

### 4.3.6 Cultural Environment

The cultural environment section consists of an investigation undertaken by 3D/Environmental Services, Inc. of Alexandria, Virginia. Architectural history and survey services were provided by the firm of Kise, Franks and Straw, of Philadelphia, Pennsylvania. The result of this investigation is a report (included as Architectural and Archaeological Cultural Resources Inventory) entitled *Architectural and Archaeological Cultural Resources Inventory for NASA's Wallops Flight Facility, Accomack County, Virginia (Preliminary Findings)*, dated December, 1991.

Research has combined background archival research with a windshield architectural survey. Based on this survey, an inventory of standing structures and a preliminary discussion of the integrity and potential significance of the buildings at Wallops Flight Facility is presented in the report.

Having researched the Virginia Department of Historic Resources files, all known archaeological sites within a 2-mile radius of Wallops Flight Facility have been inventoried, and a predictive model of potential prehistoric and historic archaeological resources has been generated (Reference 1). Wallops Flight Facility is working with the Virginia Department of Historic Resources to develop a strategy for identifying and managing cultural resources at Wallops Flight Facility.

# 5.0 ENVIRONMENTAL CONSEQUENCES

The purpose of this section is to identify activities at Wallops Flight Facility that may impact one or more resource categories described in Chapter 4.0 and to provide a qualitative description of the impacts (positive or negative) of these activities. Activities at Wallops Flight Facility were identified during on-site interviews with representatives from each code or operational group at Wallops Flight Facility. The activities identified during the interviews were sc reened to include only those that may potentially effect one of the resource categories described in this Environmental Resource Document. The list of activities can be found in Appendix L.

This chapter is organized in the same format as Chapter 4.0. Each activity that was identified as having a potential impact to an environmental resource category is described under that resource section in this chapter. For example, all activities identified to have potential effects on biological resources are described in more detail under the biological resources section of this chapter.

## 5.1 PHYSICAL FACTORS

The descriptions in this chapter are qualitative discussions of potential impacts from ongoing operations. This Environmental Resource Document is not intended to provide a quantitative analysis of potential impacts or to determine the magnitude of the impacts discussed.

### 5.1.1 Land Resources

The following items have been identified as activities that have the potential to affect the land resources of Wallops Flight Facility:

- Earth Science Studies conducted by Wallops Flight Facility have a positive effect on the ongoing study of the earth's natural resources, including land resources. The Earth Science Studies gather information used to develop topographic maps and expand knowledge of ecosystems. Balloons and sounding rockets launched from Wallops Flight Facility carry payloads that gather this data using sensors. Expanded knowledge of earth's ecosystem allows decision-makers to develop science-oriented policies for the management and protection of earth's natural resources.

- The unique land resources of Wallops Flight Facility provide a positive benefit to scientific research and educational organizations such as the Marine Science Consortium. Wallops Flight Facility serves as the primary training facility for the Marine Science Consortium.

- The Wallops Flight Facility is used as a training facility for the Emergency Vehicle Operations Class sponsored by the Criminal Justice Services Commission. The availability of Wallops Flight Facility provides a positive benefit to the Criminal Justice Services Commission.

- The Wallops Flight Facility gun range is open to several federal agencies for training and qualifying purposes. The availability of the range provides a positive benefit to these agencies.

- Disturbance of land during new construction (particularly on the Main Base) has the potential to uncover soil contaminated by the activities of previous landowners. A preliminary investigation of the history and current conditions is performed for each Main Base construction site to evaluate the potential for environmental contamination on the site. In addition, soil gas surveys are conducted on an "as needed" basis to ensure that no volatile organic contamination exists on the site. These measures also serve to protect the health and safety of NASA employees and contractors working at or near the construction sites.

- Disturbances to the land resources may occur during expansion and development of Wallops Flight Facility, including construction of water supply lines, buildings, electrical lines, sewer lines, septic systems, and new facilities. Disturbances can include excavation of soil, land clearing, or earth moving activities. Potential negative impacts include soil erosion, loss of vegetation, changes in land uses, and loss of wildlife habitat, wetlands, or other unique land resources. Secondary negative impacts can include altered surface-water drainage patterns, impacts to water quality, and noise impacts on the environment during construction. NASA minimizes the negative impacts by requiring authorization of an excavation permit prior to any intrusive activity and by requiring sediment and erosion control measures where appropriate during construction activities.

  Through master planning and by preparing an Environmental Assessment prior to the start of construction projects, NASA evaluates the positive and negative impacts of proposed projects. This review process allows NASA to incorporate mitigation measures to minimize potential negative impacts from land development.

- Controlled underbrush burning conducted by the Wallops Flight Facility Fire Department on Wallops Island occurs on an annual basis to minimize fire hazards from the launch operations and rocket motor destruction. A gas/diesel fuel mixture is used in the controlled burning of approximately one-third of Wallops Island. The Fire Department has equipment and personnel on hand to prevent any damage to areas outside the prescribed burn area. Potential adverse impacts of this procedure include destroying flora and fauna in these areas. However, since burning is a natural component of an ecosystem, prescribed burning may act to enhance natural succession of vegetation on Wallops Island. Secondary negative impacts from burning may include increased combustion emissions to the atmosphere and potential contamination of soil, surface water, or ground water resources from unburned fuel. The positive overall impact is the protection of the safety of rocket-related operations on Wallops Island and the minimization of the potential for an uncontrolled fire and the associated widespread negative environmental impacts.

### 5.1.2 Energy Use

NASA Wallops Flight Facility operations obtain electrical power from Conectiv Power Services. Energy conservation measures undertaken at Wallops Flight Facility include participation in a peak load-sharing program with Conectiv, installation of energy-saving equipment, and operational procedures designed to reduce energy usage. Both NASA and NOAA cooperate with Conectiv in the peak load-sharing program, under which NASA and NOAA operate backup generators during times of peak energy demand. Energy-saving equipment used at Wallops Flight Facility includes high-efficiency heating units. Additional energy savings are attained through automatic shutdown of some heating units on nights and weekends. Wallops Flight Facility energy conservation measures have the potential for a positive impact to the environment through reductions in utilization of limited natural resources and reductions in the release of pollutants during electrical power generation. The majority of Wallops Flight Facility activities and operations make use of fossil fuels. Generators, boilers, vehicles, and heavy machines used for base operations have fuel oil and gasoline requirements. Wallops Flight Facility aircraft have jet fuel and fuel oil requirements. Boilers and generators that burn fossil fuels are used for heating buildings, supplying auxiliary electrical power for the base, and supplying power for special projects. Wallops Flight Facility has a high demand for electrical power due to extensive radar, transmitters, antennae, computers, radios, and other equipment. Electrical power is also required for lighting buildings and runways, and operating security and communication lines. Wallops Flight Facility energy usage has the potential for primary and secondary negative impacts to the environment. Primary impacts include the potential of soil and groundwater contamination due to leaks in fuel storage tanks, and air emissions from the burning and storage of fossil fuels. Secondary impacts include expending limited natural resources by burning fossil fuels. These impacts are minimized through routine inspection of fuel storage tanks, replacing underground storage tanks with aboveground storage tanks, providing secondary containment for aboveground storage tanks, and the implementation of a base wide energy conservation program.

### 5.1.3 Water Resources

The following items have been identified as activities that have a potential to affect the water resources of NASA Wallops Flight Facility:

- Wallops Flight Facility operates a Federally Owned Treatment Works to provide treatment for sanitary wastes generated by the facility. Approximately 96 percent of the buildings on the Main Base are served by the Federally Owned Treatment Works. The wastewater treatment process treats and minimizes pathogenic or disease-causing microorganisms found in wastes, organic materials, and nutrients that can over stimulate the growth of aquatic plants. Wastewater management provides protection of the environment commensurate with public health, economic, social, and political concerns. The Main Base Federally Owned Treatment Works provides treatment of wastewater that removes wastes through biological, chemical and physical processes. Treated effluent from the Federally Owned Treatment Works is discharged to a tributary of Little Mosquito Creek. The treatment plant operates under the requirements of a Commonwealth of Virginia VPDES permit (No. VA0024457). The VPDES permitting requirements are comparable if not more stringent to the National Pollutant Discharge

Elimination System (NPDES) requirements developed to protect the quality of receiving waters. Negative impacts to receiving waters can occur should permitted wastewater treatment systems be operated in a manner inconsistent with the VPDES permit requirements. Positive impacts include the treatment of wastewater into clean water for release to the natural environment. Additionally, the Federally Owned Treatment Works is presently operating below capacity and is therefore, capable of handling increased flows from future development without facilitating major expansion to existing structures.

- NASA Wallops Flight Facility maintains 19 septic systems located at various sites among the Main Base, Mainland, and Wallops Island. See Figure 4-5 (a) and (b) for the location of each septic system. These septic systems are designed to minimize impacts to groundwater through the collection of sanitary sewage for further treatment. The septic systems have the potential to contaminate groundwater if not properly maintained. NASA Wallops Flight Facility operates a pump truck to routinely clean out septic tanks. The removed septic tank contents are discharged into the head-works of the Federally Owned Treatment Works and treated with other wastes entering through the wastewater collection network. Positive impacts in the management of wastewater conducted by NASA include construction of a force main from Wallops Island to the Main Base Federally Owned Treatment Works to eliminate a lagoon system for wastewater treatment on Wallops Island. The force main was completed and operational in 1993. Although septic systems are still in use at Wallops Flight Facility, the construction in 1993 of the force main from Wallops Island to the Main Base Federally Owned Treatment Works has phased out the use of the lagoon treatment system and a discharge to Hog Creek. No measures are under consideration to continue phaseout the use of current septic systems until activity and operations increase proportionately to warrant such action. An additional positive impacts in wastewater management was the construction of a force main to transport wastewater from the M-15 Pegasus Operations Building, thereby allowing for the elimination of septic systems in the M-building area of the Main Base.

- A positive environmental impact has been the closure of the wastewater treatment lagoons on Wallops Island allowing shellfish harvesting in Hog Creek to resume.

- Contaminants entering the sewer and storm drainage systems have the potential to negatively impact groundwater and surface waters. Floor drains that have not been plugged, typically discharge to the wastewater treatment system. Potential negative impacts to surface waters could result from spills of large quantities of toxic or hazardous materials that enter the floor drains, disturbing the wastewater treatment process. To minimize negative impacts from wastewater treatment upsets, laboratory monitoring of the wastewater sludge and effluent occurs daily to detect evidence of unreported spills and to adjust the operational parameters of the treatment process as required.

- Runoff generated through rainfall or washing activities has the potential for impacting surface water and groundwater resources through surface water recharge or infiltration from leaking storm water lines. Runoff on the Main Base from paved areas, including the runways, is directed to the Wallops Flight Facility storm drain system. Storm water

drainage discharges to either a tributary of Little Mosquito Creek, Jenney's Gut, or areas with no outlets to surface waters. To minimize impacts of oil and grease discharges to surface water, NASA has constructed an airplane wash rack near Building D-1 on the Main Base that includes an oil/water separator with separated water discharged to the Main Base Federally Owned Treatment Works or the storm sewer. Storm water runoff from the wash rack area only enters the storm drain system when washing activities are not being performed. The water collected at the aircraft wash rack area, can be directed to the Wallops Flight Facility storm drain system or to the Main Base Federally Owned Treatment Works. This facility has a positive impact through elimination of wash water discharge to the surface water via the storm drain system. Storm water systems are inspected, considered, and scheduled for periodic facility rehabilitation.

- Several operations have the potential to negatively impact water resources. Some of these are vehicle and aircraft maintenance, fuel filling operations chemical storage, staging, and testing areas. These areas all have the potential for spills or releases where flushing of material into unassigned drains can lead to surface and groundwater contamination. To minimize these potential impacts, NASA has implemented a policy that requires an observer to watch all fueling operations and to report spills or releases ensuring immediate implementation of spill prevention and control measures. This practice is described in further detail in Section 5.1.9, Regulated Substances.

- Water quality effects from proposed vehicle launches will vary based on the components of the rocket motor fuel. Sources of environmental impacts from rocket launches include wastewater treatment plant influent from operation support personnel, runoff, accumulation of spent stages, and accidental release potential. Individual rocket motors are assessed to identify potential impacts.

### 5.1.4 Wetlands and Floodplains

The following items have been identified as activities that have a potential to impact the wetlands and floodplain resources of NASA's Wallops Flight Facility:

- Wallops Island is located within the 100-year and 500-year floodplains; therefore, all ongoing activities on Wallops Island have the potential to be impacted by floods. NASA has acknowledged that Wallops Island is "an extremely valuable, unique but limited resource," (Reference 68) and has developed guidelines for restricting the use of the island to assure adequate protection of the island's floodplain resources and to minimize impacts:

    - Wallops Island is a barrier island with a fragile ecology that contains large areas of wetlands and habitat for endangered species. The cumulative impact of operations/facilities and mitigation projects will be considered in evaluating proposed additional activities.
    - Only those proposed activities that are clearly justified on the basis of technical considerations for performance can be conducted on the island.

- The number of personnel conducting activities on Wallops Island will be kept to the minimum necessary to meet function requirements.
- Wallops Flight Facility will operate and maintain core launch and launch support facilities on Wallops Island between launch areas 0 through 5. As a rule, only launch and launch related activities are conducted in this area.

- All new construction on Wallops Island will impact a floodplain area, and some new construction on the Main Base and Mainland may impact floodplain areas. NASA has procedures in place for evaluating actions impacting wetlands and floodplains (Reference 11). These procedures include early public notice of proposed construction in these areas and use of the basic criteria found in the *Floodplain Management Guidelines for Implementing EO 11988* (Reference 14). These criteria are:

  - Avoid long and short-term adverse impacts associated with the occupancy and modification of floodplains and wetlands.
  - Avoid direct or indirect support of floodplain and wetlands development wherever there is a practical alternative.
  - Reduce the risk of flood losses.
  - Minimize the impact of floods on human health, safety, and welfare.
  - Restore, preserve, and protect the natural and beneficial values served by floodplains and wetlands.
  - Develop an integrated process to involve the public in the floodplain and wetlands management decision-making process.
  - Incorporate the Unified National Program for Flood-Plain Management.
  - Establish internal management controls to monitor NASA actions to assure compliance with EO 11988.

- Construction projects or NASA activities that have the potential to impact wetlands and floodplains are reviewed by the Environmental Office on a case-by-case basis to determine the impact(s) on wetlands and floodplains. Permits are pursued, if required, in accordance with Federal, State, and local requirements. To minimize impacts to wetland areas, environmental assessments are performed on all practicable alternatives for NASA construction projects to determine which alternative has the least impact to wetlands.

- The rehabilitation of the seawall on Wallops Island has an impact on coastal primary sand dunes, wetlands, and floodplain resources of the island. The seawall is designed to protect the rocket launching area from flooding by storms with a recurrence interval of 20 years or less. It is also designed to prevent shoreline erosion that could damage the structural integrity of rocket launching pads. The seawall is a manmade control that may impact the natural dynamic evolution of a barrier island. The seawall helps prevent the risk of flood loss on the island, and therefore meets one of NASA's goals for the management of floodplains.

- Effluent from storm drains and the wastewater treatment facilities discharge into wetland areas. The potential for negative impacts to wetland flora and fauna habitats could result from discharge of inadequately treated wastewater or storm water containing pollutants,

solids, or excess nutrients. Wetlands near point source discharges could be altered if they receive an overloading of nutrients, causing an imbalance of the ecosystem. If wetland areas are damaged or destroyed, a secondary impact may be the loss of wildlife habitat areas and food sources. Effluent from the wastewater lagoon system on Wallops Island was discharged near a wetland area associated with the Hog Creek. The force main constructed from Wallops Island to the Main Base in 1993 eliminated the periodic discharge from the lagoons, thereby removing this negative impact.

- Rocket launches are not expected to directly impact wetland areas. Ground cloud formation from rocket launches may result in short-term impacts to vegetation in the areas surrounding the launch pads. Loss of vegetation may cause soil erosion and subsequent leaching of sediment, particulate matter and nutrients that may eventually discharge into wetland areas. Increased sediment, particulate and nutrient loads have the potential to negatively impact benthic species in the wetland system. (Reference 31).

### 5.1.5 Air Quality

The following activities have been identified which have the potential to impact air quality resources:

- The release of toxic gases through laboratory fume hoods and from projects with emissions of air pollutants at Wallops Flight Facility have the potential to impact the local air quality. Accidental release of toxic gases stored at Wallops Flight Facility would also have a negative impact on local air quality. A staff Industrial Hygiene Technician and the GSFC's Environmnetal Office review complaints on air quality and perform air quality surveys. Ventilation systems are also reviewed to assure compliance with American Conference of Governmental Industrial Hygienists (ACGIH), and American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE), standards. The GSFC's Environmental Office also evaluates air quality for permitting purposes.

- Several ongoing operations use equipment that have the potential to generate emissions that could negatively impact the local air quality. This equipment may increase the discharge of regulated air pollutants. Operations that could potentially result in emissions of regulated pollutants include airport operations, rocket launches, wastewater treatment operations, welding, and electroplating. Emissions from paint shops, fuel storage areas, the print shop, laboratory hoods, or boilers could negatively impact local air quality. To minimize the release of regulated air pollutants, NASA complies with the permit requirements for stacks at the Central Boiler Plant. Smaller boilers in individual buildings do not require permits. Regulatory emissions limits have been established by the Department of Air Pollution Control for NASA's two paint spray booths and emissions controls have been installed to control the discharge of pollutants.

- Rocket motor emissions may have a small negative impact on air quality. Factors such as infrequent launches, dispersion, and inappreciable emission quantities released lessen the negative effects of the emissions on air quality. Additionally, NASA has instituted the use of solid rocket motors for scheduled launches in an effort to produce significantly less

environmental impact compared to previously used rocket fuels such as hydrazine. The recent expansion of launch range capabilities at Wallops Flight Facility has been evaluated to indicate that such activity will not significantly add to environmental impacts of air quality from emissions.

- Halon used in fire suppression systems has the potential to impact local air quality and global atmospheric conditions by depleting ozone. Halon fire suppression systems are currently being phased-out by the Navy ACSC-AEGIS. The 1990 Clean Air Act Amendments mandated a complete phase-out of halon by the year 2000 since it is an ozone depleting substance. NASA has replaced the halon systems with alternative fire suppression systems, specifically carbon dioxide or water systems.

- Daily weather balloons launched from Wallops Flight Facility are used to forecast the weather for project monitoring and for use by the National Weather Service. Gathering of weather data provides a positive benefit to Wallops Flight Facility projects and to our understanding of the atmosphere and weather patterns. Without detailed local weather information, Wallops Flight Facility launch activities could be jeopardized and potentially more dangerous due to inaccurate weather data. Balloons are inflated with helium, which is not listed as an air pollutant under Title III of the Clean Air Act.

### 5.1.6 Radiation

The following activities have been identified which have the potential to impact the Wallops Flight Facility environment due to their radiation resources:

- The GSFC Radiation safety Committee reviews all radiation issues, including licensing issues and inter- and intra-state and foreign shipments.

- Non-ionizing radiation sources may have a potential negative impact to biological organisms, including humans. Radio frequency devices include radar, radios, microwaves, and telemetry devices. A literature review was done on the biological effects of radio frequency radiation and lasers, which are the two most common sources of non-ionizing radiation used at Wallops Flight Facility. The greatest potential bioeffect of non-ionizing radiation sources is the potential for lasers to damage the skin and eyes of humans. A more detailed description of the bioeffects of non-ionizing radiation can be found in Appendix C.

- Radar, which is another source of non-ionizing radio-frequency radiation, is used at Wallops Flight Facility for tracking ships, aircraft, launched rockets, and missiles. To minimize the potential for negative impacts to humans from radar, each system has been evaluated for its safety and radar safety distances have been established. Radar can potentially affect explosives; therefore, rocket motor storage buildings and other explosives storage areas are located beyond these safety distances. Transmitters emit signals to aircraft, ships, and satellites and antennae receive signals from these sources. The ACSC uses radar and radios in combat training programs, and the NSWC uses radar in tracking exercises. NOAA uses radio transmitters to receive information from the

Geostationary Operational Environmental Satellite (GOES) and from polar orbiters. NOAA also uses antennae to send commands to assist in satellite guidance. Infrared light is used to passively track aircraft, boats, and missiles. The Radiation Safety Committee provides a positive benefit by defining potential hazards and preventative measures for each system prior to its radiating. These potential hazards and preventative measures are based on a worst case analysis.

- The GSFC Radiation Safety Committee provides a positive impact by overseeing the use of non-ionizing radiation sources to ensure protection. Prior to the arrival of non-ionizing radiation sources at Wallops Flight Facility, information on the sources is obtained and reviewed by the Radiation Safety Committee. Safety standards for non-ionizing radiation sources are included in Appendix C.

- Table 4-25 lists the sources of ionizing radiation at Wallops Flight Facility. These sources include calibration sources, radioactive devices such as Tritium exit signs and ionizing smoke detectors, and x-ray producing devices. All sources of ionizing radiation are used and/or stored at Wallops Flight Facility under a radiation protection program, that is overseen by NASA's Radiation Safety Committee. Because protection guidelines must be followed for all radiation-emitting sources and equipment, the potential for human exposure to ionizing radiation is minimal. However, if human radiation exposure were to occur, the potential impacts could include cancer, cataracts, sterility, and genetic defects. The Radiation Safety Committee surveys ionizing radiation devices, and, if necessary, properly disposes of the devices. This procedure provides a positive impact to Wallops Flight Facility.

- Environmental radiation safety is maintained by monitoring, inspecting, and maintaining radioactive items and the areas these items are located in. Film badges and other devices are used for monitoring personnel, areas where radioactive sources are used and stored, and radioactive sources. Inspections of areas where radioactive sources are used or stored occur periodically. In the event an area or items are found to be above the Wallops Flight Facility limits, proper decontamination methods are performed.

### 5.1.7 Noise

The following activities have been identified which have the potential to generate noise that could impact the environment:

- Mechanical noise sources from daily operations at Wallops Flight Facility include aircraft operations, vehicular traffic, stationary and portable generators, pumps, fire engines, heating and air conditioning units, and equipment used in industrial shops. For many of these sources, exposure to noise is either short-term (e.g., fire engines), or can be minimized through use of personal hearing protection. The Range Safety Office is responsible for occupational safety and determining the need for personal hearing protection.
- Wallops Flight Facility is used for landing and take-off exercises, or "touch-and-go," by military pilots who need practice time and to test instrumentation and equipment. These

exercises can provide an almost constant noise source for several hours at a time. This activity provides a secondary positive socioeconomic benefit to pilots (typically from the Uniformed Services) who are able to use the facility to perform these required exercises, to scientists who need to test instrumentation and equipment.

- Project-specific noise sources at Wallops Island include rocket and missile launches. The rockets and missiles are generally launched over water from the Island and the noise generated is usually low frequency and of short duration. Rocket launches can be heard throughout the surrounding community; however, not at levels which generate complaints or damage property. All non-essential personnel are evacuated from the hazard area during a launch. All essential personnel are restricted to a blast-proof building called a blockhouse. Personnel outside the hazard area may be restricted to their buildings depending on the size of the hazard area. Despite the noise from rocket launches, the piping plover population has survived and continues to nest in the Wallops Island area.

- Throughout Wallops Flight Facility, project-specific construction activities generate increased noise levels from heavy equipment operations. The increased noise levels due to construction activities are localized and temporary.

- Cannon-like noises generated by a propane tank are used for bird control in the vicinity of the runways. The use of guns by United Stated Department of Agriculture (USDA) licensed sharpshooters for deer and bird control is sometimes necessary. Human exposures to noise from the guns, which can be addressed by personal hearing protection, are infrequent and of short duration.

- Security and Coast Guard personnel fire handguns at the firing range as part of training requirements. Personal hearing protection is worn and the exposure to noise impacts are infrequent and of short duration. The firing range is located on the northwest side of the Main Base, away from most activities.

- Environmental Health personnel conduct baseline surveys of each new operation, conduct annual walk-through surveys, monitor and evaluate noise hazards, and recommend appropriate means of controlling noise exposures.

### 5.1.8 Solid Waste

The following activities have been identified which have the potential to impact the environment due to solid waste sources:

- Virtually all activities at Wallops Flight Facility produce some amounts of municipal solid waste; and, therefore, have the potential for an impact due to solid waste generation. Some examples of these activities include: the deployment of scientific balloons resulting in waste latex, polyethylene film, and metal tape; equipment past its useful life disposed of as solid waste; offices generating waste paper; the cafeteria producing food waste; etc. Improper or poorly managed disposal of solid waste can cause negative impacts to the environment, including contamination of water sources from leaching,

methane gas generation, and loss of land resources due to landfill operations. NASA generated approximately 309 tons of solid waste in 1998 that were disposed of in the local Accomack County landfill. This landfill is projected to have adequate space for waste disposal until the year 2001. To minimize solid waste generation and disposal impacts, NASA has recently developed and implemented various recycling programs. These programs are designed to minimize the impact to the environment created by the disposal of metal, oil, cardboard, antifreeze, freon, solvents, and paper generated by NASA. A secondary positive impact of recycling is on the socioeconomic environment. Future plans include cooperating with other federal agencies in the area to accumulate recyclable materials. As a result of the recycling programs, employees are given the opportunity to contribute toward a common public benefit.

- Sources of hazardous waste have the potential to impact the environment. The major generators of hazardous waste at Wallops Flight Facility are listed in Section 4.1.8.2.2. The combined activities at Wallops Flight Facility generated over 33,500 pounds of hazardous waste in 1997. The hazardous waste is stored (for less than 90 days after generation) in accumulation areas on-site. NASA uses private contractors to transport and dispose of the hazardous waste off-site. The greatest potential impact to the environment would result if an accident were to occur at an accumulation or staging facility (e.g., spill, fire, or explosion). The effect an accident would have on the environment (e.g., release of toxic gases, soil contamination, surface water contamination) would vary greatly depending upon the type of accident and properties of the hazardous waste involved. Secondary impacts could occur to groundwater and air. Wallops Flight Facility has implemented various controls to prevent or minimize the effect of an accident involving hazardous waste, including the following:

    - All wastes are stored in closed containers, and accumulation areas have the capability of containing a leak or spill.
    - The containers are inspected for leaks on a scheduled basis.
    - All civil service and contractor personnel who handle hazardous wastes as part of their job are trained in hazardous waste management procedures. This training includes an initial 40-hour Hazardous Waste Operation and Emergency-Response Course and an annual 8-hour refresher course.
    - A communication/alarm system is in place that is capable of providing immediate emergency instructions to facility personnel in the event of an accident and summons emergency assistance
    - Fire extinguishers/fire control equipment are available on-site.
    - A contingency plan has been developed to deal with releases of hazardous waste.

- The sludge generated at the Main Base Federally owned Treatment Works is now disposed of in Accomack County's Oak Hall landfill. Pretreatment of waste streams has enabled the sludge to be classified as non-hazardous.

### 5.1.9 Regulated Substances

The following activities have been identified which have the potential to impact the environment due to the presence of regulated substances:

- Various Wallops Flight Facility operations require the use of regulated substances including pest management (pesticide), heating (fuel oil), rocket launches (propellants), etc. An inventory of toxic chemicals, with the storage location and quantity, is maintained by the Environmental Office. The greatest potential impact to the environment due to the presence of toxic chemicals, hazardous substances, or petroleum products would result from an accident at a storage location (leak, fire, explosion) or during the use of the substance (spills, human exposure). The short-term and long-term effect of an accident on the environment would vary greatly depending upon the type of accident and the properties of the substance(s) involved.

- Wallops Flight Facility has implemented various controls to prevent or minimize the effects of an accident involving regulated substances, including:

    - NASA has prepared a Spill Prevention, Control, and Countermeasures Plan. Refer to Section 4.1.9.1.2, Wallops Flight Facility Spill Prevention, Control, and Countermeasures Plan.
    - NASA has prepared emergency plans and procedures that are designed to minimize the effect an accident has on the environment.
    - NASA is in the process of developing a written hazard communication program designed to minimize accidents that can occur during the use of toxic substances. The program will outline labeling, material safety data sheet, and employee training requirements.
    - NASA has prepared a list of toxic/hazardous chemicals and the associated buildings where they are stored or used.

- Contaminated sites, which have been identified by NASA and are due to past activities by previous owner/operators and NASA, are being evaluated, remediated, and closed under the regulatory requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Additional site investigations are occurring to define the location and extent of contamination in other areas used by NASA and the previous owner/operator for storage or disposal activities.

## 5.2 BIOLOGICAL FACTORS

This section includes the resource categories of Biological Resources and Threatened and Endangered Species.

### 5.2.1 Biological Resources

The following activities have been identified which have potential impacts to biological resources:

- NASA has established osprey platforms in the marsh between the Mainland and Wallops Island. The osprey platforms are used for nesting, and ospreys have been observed using

the platforms. A falcon hacking tower has also been established in the same marsh area for the same reasons. These platforms provide positive benefits to these species and scientists who study them.

- Deer and birds near the Wallops Flight Facility runways can pose a safety hazard. Wallops Flight Facility is permitted to exterminate deer and birds that interfere with the runway operations. Deer and birds are shot by USDA licensed sharpshooters as a method of controlling their populations on the Main Base. Deer carcasses are field dressed and given to a local organization for further processing and distribution to area shelters and food banks. Wallops Flight Facility maintains a state issued depredation permit as well as a NASA agency permit to allow hunting on its premises. Deer and wildfowl hunting is allowed by the general public in limited numbers of persons on Wallops Island during the Commonwealth's hunting season. Hunters must have a current license to hunt and abide by hunting regulations. Regional deer populations are plentiful in numbers at times to be considered a nuisance and can pose a negative impact to neighboring agricultural areas due to excessive foraging. The extermination of deer populations inhabiting Wallops Flight Facility Main Base is not likely to have a negative impact to overall deer populations. The impact to exterminating deer and bird populations is considered to be positive to the overall health of remaining populations especially during times of overcrowding.

- Ultraviolet light transmission is used to control pathogens in wastewater generated from the Federally Owned Treatment Works at Wallops Flight Facility. Ultraviolet light replaces the previous treatment method of chlorination. This change in the treatment process has a positive impact on human and wildlife populations by reducing vector borne pathogenic bacteria and by eliminating toxicity effects of chlorine to smaller forms of aquatic animal life (which contributed to an adverse affect on the environment).

- To minimize the negative effect to humans from biting insects (green head flies), controls have been installed on Wallops Island to reduce their numbers, including black box insect traps surrounding the AEGIS facility. These boxes have been effective in reducing the fly population and are a non-toxic alternative for controlling biting insects. Dead flies are eaten by ants, thereby, keeping the flies in the food chain and minimizing the negative impact of reducing their numbers.

- Pesticides are used selectively throughout the facility to control disease vectors and nuisance pests such as mosquitoes,termites, roaches, bugs, and mice. Malathion is used in sprayed applications to control mosquitoes on the Main Base and the Wallops Visitor's Center in small areas where their concentrations are high. Roaches are controlled by spraying Dursban in some buildings. Contractors who maintain Class II Pesticide Applicator licenses perform pest management at Wallops Flight Facility. A negative impact from the use of pesticides is the potential for pesticides to accumulate in the environment and to impact water resources. In addition, many pesticides are nonselective and may destroy beneficial insects as well as pests. Indiscriminate use of pesticides may also cause resistance in some species.

- Grounds are maintained by mowing, clearing the underbrush, and using herbicides. The herbicide, Hyvac™, is used in limited quantities to kill weeds in cracks near pavement areas, particularly around the runway. Improperly used herbicides can kill other nearby plant species unintentionally or if applied in excessive quantities, could be toxic to some animals. Use of proper application rates and care in application techniques are stressed to minimize any adverse effects.

### 5.2.2 Threatened and Endangered Species

- NASA has designated protected closure areas as recommended by the United States Fish and Wildlife Service and the Virginia Department of Game and Inland Fisheries for piping plovers on the northern and southern portion of Wallops Island. These agencies monitor the presence or absence of birds in the areas NASA agreed upon for closure. If birds do not use an area for nesting, that area is reopened to public access. Otherwise, NASA complies with the United States Fish and Wildlife Service dates of March 15th through September 15th piping plover nesting area closure. This closure area has a positive environmental impact and allows this endangered species to successfully reproduce. The Wilson's plover, a State endangered bird, also benefits from the closure area since it thrives in a similar habitat.

- Proposed critical habitats include two small areas in the northern portion of Wallops Island and the southern portion of Wallops Island. These proposed critical habitat areas fit specific habitat criteria "Critical" to the piping plover's survival. These areas remind NASA of the need to use caution in disturbing such areas to avoid adverse effects upon the inhabitants.

## 5.3 SOCIAL AND ECONOMIC FACTORS

This section includes the resource categories of Socioeconomic Environment and Cultural Resources.

### 5.3.1 Socioeconomic Environment

- Notice is given to commercial fisherman and mariners of any rocket launches that will occur over water. Rocket launches will not proceed until the designated area has been satisfactorily cleared to minimize the impacts of the launch (e.g., noise from emissions and the possibility of falling debris) to humans. NASA communicates and coordinates activities with local fishermen and recreational boaters. NASA's surveillance, presence, and communications provide a positive benefit to boaters in the area because NASA's efficient ship-to-shore communications can help provide assistance in emergencies.

- NASA provides a positive community impact to the surrounding educational systems by providing educational tours of the facility to area schools. Additionally, NASA staffs the Wallops Visitors Center and maintains an Education Resource Center for use by educators in preparing lessons on scientific topics. Beyond educational services available

on site, NASA Wallops Flight Facility personnel also provide scientific stewardship information to organizations by performing lectures at schools and aiding as judges for school science fairs.

- An expansion of the Navy facilities is underway for the Main Base. The construction of new housing facilities for the Main Base is helping to alleviate the current housing demand. Family housing facilities on Wallops Flight Facility are currently filled to capacity with a waiting list. Housing available in the immediate vicinity is also limited and includes older single-family homes as well as vacation homes usually available only for winter rentals. Included in the Navy expansion has been the construction of an annex that includes a retail store, cafeteria, service outlets, an exchange warehouse, and a clothing/uniform shop. Otherwise, retail sales facilities available on-site are the Wallops Exchange, cafeteria, and the Wallops Visitors Center gift shop. The increase in these types of facilities benefit employees and enlisted personnel by providing options of economically beneficial purchases with an increased variety of goods available at the facility.

- Employees from the local community, including civil service personnel and contractors, benefit from NASA's presence through a steady source of employment and increased revenue for businesses. The specialized workers brought into Wallops Flight Facility help to increase the tax base thus helping the local economy. Wallops Flight Facility is the third largest single employer in Accomack County, and employs approximately 5 percent of the total workforce in Accomack and Northhampton Counties. The continued expansion of operations at Wallops Flight Facility will increase the employment demands and benefit the community as a prominent source of employment. This expansion will also result in increased tax revenues, thus helping the local economy.

### 5.3.2 Cultural Resources

- Wallops Flight Facility coordinates construction project activities with the Commonwealth of Virginia Historic Preservation Officer as required by the National Historic Preservation Act Section 106 (Reference 13).

- Range users, Wallops Flight Facility employees and their families, and Wallops Flight Facility visitors contribute positive effects to the socioeconomic environment in the Wallops Flight Facility area. Although the surrounding communities do have a reliable seasonal business, Wallops Flight Facility contributes to off-season as well as seasonal business.

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